شركة مرافق الكهرباء والمياه بالجبيل وينبع (مرافق ower and Water Utility Company for Jubail and Yanbu



KINGDOM OF SAUDI ARABIA

Gas Turbine Generators

Rehabilitation by Replacement of

Major Parts - YANBU

Contract PO # 720 002 6909 (Volume 1 of 3)

Attachment A

Attachment B

Pre Bid Clarifications

peral Electric International In

CONTRACT DOCUMENTS







Gas Turbine Generators Rehabilitation by Replacement of Major Parts - YANBU

Contract PO # 720 002 6909

(Volume 1 of 3)
Attachment A
Attachment B
Pre Bid Clarifications

General Electric International Inc.



GTG Rehabilitation by Replacement of Major Parts — Yanbu

إعادة تأهيل مولدات توربينات الغاز من خلال استبدال العدد الأجزاء الرئيسية - ينبع

Between

بين

Power & Water Utility Company For Jubail & Yanbu (Marafiq)

شركة مرافق الكهرياء والمياه بالجبيل و ينبع (مرافق)

And

9

General Electric International Inc (GEII) شركة جنرال الكتريك انترناشول انك

Contract P.O. No. 7200026909

عقد رقم: ۲۲۹۰۹

P.O. Bord 1801 (C.C. 1-1711 / C.C. 1-1711 /

Jubail (Head Ofice) PO Box 11133 • Jubail Industrial City 31961 Tel +966 13 340 1111 • Fax +966 13 341 6129

Yanbu PO Box 30144 • Yanbu Industrial City Tel +966 14 396 6000 • Fax +966 14 396 2022 Kingdom of Saudi Arabia

إدارة الشَّتريات والعقود PROCUREMENT :

CONTRACTS DEPT.

ينبع عدينه ينبع الصناعية من ب ٢٠١٤٤ مانف : - ٦ ١٩٣٦ ١٦ ١٦٩٠ مانس ١٢ ٦ ١٩٣٦ ١٢٩٠+ المملكة العربية السحودية IN SE

شركة مساهمة سعودية رأس المال (2500) مليون ريالمدموع بالكامل س ب (2055004968) Paid-up capital SR 2,500 million CR 2055004968

marafiq.com.sa

Page 1of 6

The Contract

السعودية في اليوم ٢٢ من شهر شعبان عام ١٤٣٧هـ الموافق Saudi Arabia as of 22 Shabaan 1437 H, corresponding to 29 May 2016 G.

Between

Power & Water Utility Company for Jubail and Yanbu (Marafig) established by Royal Decree No. M/29 dated 21 Rajab, 1421H, corresponding to 19th October 2000, represented by Mr. Yousif Othman Al-Khlaiwy, Vice President Corporate Services, duly authorized to enter into this Contract.

First Party

P.O. Box / 10211 Riyadh / 11477

1010223377

CONTRACTS DEP

And

General Electric International Inc., organized under the laws of Saudi Arabia, represented by Mr. Hassan Elokdi, Commercial Director duly authorized to enter into this Contract.

Second Party

Whereas, First Party has been given the responsibility by the above-mentioned Royal Decree for the and maintenance, operation management, construction, developments and expansion of the utility systems for seawater cooling, treated, desalinated water, wastewater and power systems A Jubail and Yanbu industrial cities in K.S.A.

العقد

This Contract is entered into in Jubail Industrial City, تم إبرام هذا العقد بمدينة الجبيل الصناعية بالمملكة العربية ٢٩ من شهر مايو عام ٢٠١٦ م.

سن کل من

شركة مرافق الكهرياء والمياه بالجبيل و ينبع (مرافق) وهي شركة تأسست بموجب المرسوم الملكي رقم م/٢٩ و تاريخ ٢١ رجب ١٤٢١هـ الموافق ١٩ أكتوير ٢٠٠٠م ممثلة بالسيد/ يوسف بن عثمان الخليوي، نائب الرئيس للخدمات التنفيذية والمفوض بإبرام هذا العقد.

طرف أول

شركة جنرال الكتريك انترناشونال انك وهي شركة تأسست بموجب قوانين المملكة العربية السعودية، ممثلة بالسيد/ حسن العقدى، المدير التجاري والمفوض بإبرام هذا العقد.

طرف ثانی

وحيث أن الطرف الأول مستول بموجب المرسوم الملكي المذكور أعلاه عن أعمال تشغيل وصيانة وإدارة أعمال التوسعة لأنظمة التبريد بمياه البحر وأنظمة المياه المحلاة والمعالجة وأنظمة الصرف الصحى والصناعي وأنظمة الكهرياء لمدينت الجبال وينبع الصناعيتين بالمملكة العربية السعودية. ادارة الشريان والعقود إ

مـرافــق MARAFIQ



Whereas, the First Party desires the Second Party to perform the work set forth in Article "1" of this Contract.

وحيث أن الطرف الأول يرغب في قيام الطرف الثاني بإنجاز العمل المنصوص عليه في الفقرة "١" من هذا العقد.

عليه فقد اتفق كل من الطرفين على ما يلي:

Now, Therefore, both parties hereby agree as follows:

- WORK TO BE PERFORMED: The Second Party shall perform the work of required by the First Party as per Attachment "D".
- 2. **DOCUMENTS INCORPORATED**: The following attachments are by this reference incorporated herein and made a part of this Contract:
 - Attachment "A" General Terms & Conditions
 - Attachment "B" Special Conditions

 - Attachment "D" Scope of Work
 - Attachment "E" HSE & Fire Prevention Management Plan

- العمل المطلوب تغفيذه: يتعين على الطرف الثاني القيام بالخدمات المطلوبة للطرف الأول حسب ما هو وارد في الملحق "د".
 - الوثانق اللحقة: تعتبر الملحقات التالية والملحقة بهذا العقد جزءا لا يتجزأ من هذا العقد.
 - ☞ ملحق "أ" الشروط والأحكام العامة
 - ملحق "ب" الشروط الخاصة
 - 🖘 ملحق "ج" السعر والدفع
 - 🖘 ملحق "د" نطاق العمل
 - ▽ ملحق "ه" خطة إدارة السلامة ومكافحة الحريق
- 3. Regulations for Application: The Contract and its documents shall be subject to all laws, regulations, decisions and orders related thereto, e.g., the Labor and Workman's Law, the Social Insurance Law, and the relevant supplements. In case a conflict arises between said laws and the Contract and its documents, the provisions of such laws and their supplements will prevail.

تسود.

مـرافــق MARAFIQ



4. **Period of Performance:** Second Party shall perform the work under this Contract for a period of Thirty Six (36) Gregorian Months commencing from 15 April 2016

The Contract shall be subject to extension or termination in accordance with the First Party requirements.

- 5. Price & Method of Payment: The First Party shall pay to the Second Party the price as set forth in Attachment "C" of this Contract, subject to a ceiling price of Saudi Riyals Five Hundred Ninety Seven Million (SR597,000,000.00).
- 6. Designation of Authorized Representative:

Manager, Projects Dept. - Yanbu

7. **Notice**: All formal notices required or permitted under this Contract shall be considered as duly given in writing and hand delivered or sent by registered mail to the First Party or the Second Party at their office addresses set forth below, or to such other address as may be designated by formal notice given as herein required. Formal notices may, however, be given initially by telex, fax, telegram or cable provided that confirmation of such notice is received in compliance with the foregoing provisions within fifteen (15) days of the date of the initial notice. All notices shall be effective upon first receipt.

- أ. فيرة التنفيذ: على الطرف الثاني القيام بتنفيذ جميع الأعمال المطلوبة منه والمنصوص عليها في هذا العقد خلال مدة اقصاها ستة وثلاثون (٣٦) شهر ميلادياً تبدأ من ١٥ أبريل ٢٠١٦.
- كما يخضع هذا العقد للتمديد أو الإنهاء وفقا لمتطلبات الطرف الأول.
- السعر و طريقة الدفع: يدفع الطرف الأول للطرف الثاني كما هو موضح في الأسعار المدرجة في منحق "ج" من هذا العقد و بحد أقصى مبلغ وقدره خمسمائة وسبعة وبسعون مليون (٠٠٠,٠٠٠,٠٠٠ دريال سعودي).

٦. تعيين المثل الفوض:

مدير ادارة المشاريع – ينبع

٧. الإشعارات: يعتبر كل إشعار رسمي لازم أو مسموح به بموجب هذا العقد أنه مبلغ بشكل صحيح إذا كان مكتوبا ومسلما باليد أو مرسلا بالبريد المسجل إلى الطرف الأول أو الطرف الثاني وموجها إلى عناوين مكاتبهم الموضحة ادناه، أو إلى أي عنوان آخر قد يحدد بواسطة إشعار رسمي مرسل بالشكل المطلوب بموجب هذه المادة. على أنه يمكن أن ترسل الإشعارات الرسمية في بادئ الأمر بتلكس أو ببرقية أو بفاكس أو تتغراف شريطة أن يستلم التعزيز لمثل هذا الإشعار وفقا للأحكام المنصوص عليها آنفا خلال خمسة عشر(١٥) يوما من تاريخ الإشعار الأول، ويسرى مفعول الإشعارات قور استلامها.

مــرافــق MARAFIQ



First Party:

Power & Water Utility Co. for Jubail & Yanbu (MARAFIQ)

P. O. Box-36111

Jubail Industrial City - 31961

Kingdom of Saudi Arabia

Telephone: 013 342 9423

Fax : 013 340 1291

E-mail : contracts@marafig.com.sa

الطرف الأول:

شركة مرافق الكهرياء والمياه بالجبيل وينبع (مرافق) ص ب- ٣٦١١١

مدينة الحبيل الصناعية - ٣١٩٦١

المملكة العربية السعودية

تليفون : ۲۲ ۹ ۲۲۳ ۱۳۰

فاکس : ۱۳۹۱ ، ۱۳۴۰

بريد الكتروني: contracts@marafiq.com.sa

Second Party:

General Electric International Inc.

P. O. Box 10211, Riyadh 11423, KSA

Telephone: 011 207 3867 Facsimile: 011 200 8926

الطرف الثاني :

شركة جنرال الكتريك انترناشونال انك

ص ب: ١٠٢١١ ، جدة ١١٤٢٣

المملكة العربية السعودية

تليفون: ۲۰۷ ۳۸٦۷ ،۱۱۰

فاکس : ۲۰۰۸۹۲۱ .

8. Language of Contract: This Contract has been executed in triplicate in both Arabic and English languages; in the event of a dispute concerning the interpretation of the Contract the English text shall prevail. Two original copies of the Contract will be retained by the First Party while the third copy will be retained by Second Party.

٨. لغة العقد: تم تحرير هذا العقد من ثلاث نسخ أصلية باللغتين العربية والإنجليزية، وفي حالة نشوء نزاع حول تفسير هذا العقد فإن النص المكتوب باللغة الإنجليزية هو الذي يعتد به. ويحتفظ الطرف الأول بنسختين أصليتين من هذا العقد بينما يحتفظ الطرف الثاني بالنسخة الثالثة.



In witness whereof, both parties hereto have executed this Contract to perform the work as specified in Attachment D for the First Party.

واتباتا لما فيه، قام الطرفان بالتوقيع على هذا العقد لتنفيذ العمل كما هو موضح في الملحق د للطرف الأول.

Power & Water Utility Co. For Jubail &

Yanbu (MARAFIQ)

On its Behalf:

Signature :

Date:

Name: Yousif O Al Achlaine

Title: Vice President Corporate Services

شركة مرافق الكهرياء والمياه بالجبيل ويثبع 29/5/2016

التوقيع: التاريخ:

الاسم : يوسف بن عثمان الخليوي

الوظيفة : نائب الرئيس للخدمات التنفيذية

General Electric International Inc. (GEII)

P. 1010223377

On its Behalf:

Signature:

Date: Name: Hassan Elokdi

Title: Commercial Director

شركة جنرال الكتريك انترناشونال اتك

التوقيع:

عنها:

التاريخ : 1/05/20/6

الاسم: حسن العقدي

الوظيفة: المدير التجاري





Attachment "A" General Terms & Conditions (EPC Contracts)

Document ID No: MSSF-1-PC-054

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Rev. No.: GTG Rehabilitation Project

Date: 27 March 2016



Contract PO No. 7200026909

Gas Turbine Generators Rehabilitation by Replacement of the Major Parts - Yanbu



MARAFIQ COMPARATION OF THE PROCUREMENT & CONTRACTS DEFT.

PROPRIETARY NOTICE

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Only documents with stamps are considered official



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GC.1 DEFINITIONS

Wherever the following terms are used in this Contract, they shall have the meanings hereinafter set forth unless specifically noted otherwise in the text:

MARAFIQ

Power & Water Utility Company for Jubail & Yanbu (MARAFIQ)

The "Work"

All works and Services designated by the Contract document and other responsibilities to be performed by the Contractor as specified, stated, indicated or implied in this Contract, including the provision and supervision of all labor and personnel and to request and equipment, materials and supplies recommend necessary to perform this Contract.

"Project"

The structures, plant, equipment or items being designed, engineered, procured, fabricated and constructed by Contractor pursuant to this Contract.

"Water Utility"

All Water Utility Facilities (Seawater Cooling System, Potable Water System and Wastewater System) which include materials, facilities, supplies, provisions, plants, machinery, equipment, vehicles, tools, buildings and structures, including offices, camps, garages, shops, roads, parking and work areas, and all other items consumed or used or intended to be consumed or used in the performance of the work.

"MARAFIQ Property"

All power and water utility facilities including land and premises of MARAFIQ required for the performance of the Project. MARAFIQ property, shall include properties leased by MARAFIQ from the Royal Commission for Jubail and Yanbu.

The "Change "

Means substitutions, modifications or deletions in the scope of this Contract.

"Extra Work"

Means additions to the scope of work und Contract.

The "Work Site"

The location or locations in the Kingdom on propert owned, controlled or occupied by MARAFIQ where the work is to be performed.



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The "Contract Schedule"

The approved, updated work schedule in effect at any given time, as more fully described in the Special Conditions of Attachment "B" hereof entitled "Contract Schedule".

The "Contract Price"

The Total Compensation to be paid to Contractor in accordance with the terms and conditions of this Contract.

The agreed price stated in the Contract for the sale of Products and Services, including adjustments (if any) in accordance with the Contract.

"Days and Calendar"

Unless otherwise expressly designated, "Days" as used in this Contract shall mean calendar days and all references to "Calendar" or "Month" shall be to the Gregorian Calendar.

"Permanent Works"

The permanent works to be designed and executed by the Contractor under the Contract.

"Temporary Works"

All temporary works of every kind (other than Contractor's Equipment) required on Work Site for the execution and completion of the Permanent Works and the remedying of any defects.

"Plant"

The apparatus and machinery intended to form or forming part of the Permanent Works.

"Buyer"

The entity to which Seller is providing Products or Services under the Contract.

"Contract"

either the contract agreement signed by both parties, or the purchase order signed by Buyer and accepted by Seller in writing, for the sale of Products or Services, together with these Terms and Conditions, Seller's final quotation, the agreed scope(s) of work, and Seller's order acknowledgement. In the event of any conflict, the Terms and Conditions shall take precedence over

the Terms and Conditions shall take pre other documents included in the Contract.

"Hazardous Materials"

Any toxic or hazardous substance, hazardous male lated dangerous or hazardous waste, dangerous coedical radioactive material, petroleum or petroleum-der ved products or by-products, or any other chemical,

PROPRIETARY NOTICE

IF Only



Attachment "A" General Terms & Conditions (EPC Contracts)

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"Insolvent/Bankrupt"

"Products"

"Seller"

"Services"

"Site"



"Prudent Industry Practices"

"Force Majeure" or "Excusable Event(s)"

substance, material or emission, that is regulated, listed or controlled pursuant to any national, state, provincial, or local law, statute, ordinance, directive, regulation or other legal requirement of the United States ("U.S.") or the country of the Site.

that a party is insolvent, makes an assignment for the benefit of its creditors, has a receiver or trustee appointed for it or any of its assets, or files or has filed against it a proceeding under any bankruptcy, insolvency dissolution or liquidation laws.

The equipment, parts, materials, supplies, software, and other goods Seller has agreed to supply to Buyer under the Contract.

The entity providing Products or performing Services under the Contract.

The services Seller has agreed to perform for Buyer under the Contract.

The premises where Products are used or Services are performed, not including Seller's premises from which it performs Services.

The exercise of that degree of skill and diligence, and of such practices, methods and acts, at a minimum, as would ordinarily be expected in the power generation industry from a prudent owner and/or operator or service provider (as applicable) acting lawfully, reliably and safely in connection with power generation facilities and equipment similar to the Facility and Unit(s)."

Any circumstances beyond the control of the parties. Including but not limited to:

(a) War and other hostilities, (whether war be declared or not) Invasion, act of foreign enemies, mobilization, requisition or embargo; (b) ionizing radiation or contamination by radio-activity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel, radio-active toxic explosives, or other hazardous properties of any explosive nuclear assembly or nuclear components thereof; (c) Rebelion, revolution, insurrection, military or usurped power and civil was (c). Riot, commotion or disorder, except where solely

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"Managerial or Senior Supervisory Personnel"

restricted to employees of the Contractor, Nation wide strike of a whole category of personnel.

any person employed by Seller that is not an hourly worker, clerk, craft laborer, mechanic, foreman, subcontractor, engineer, inspector, Technical Advisor ("TA"), TA Site Manager, first level of managerial or supervisory personnel, or positions of a similar standing who in the performance of the work or Services would seek authority, approval, direction, guidance, advice and interpretation from other personnel who are (a) in a managerial or senior supervisory role at least one level higher than the first tier supervisory or managerial personnel, and (b) are directly involved in establishing and interpreting a party's policies, processes, practices and procedures in connection with the work or Services.

On the part of Seller's Managerial or Senior Supervisory Personnel, that the actor has intentionally done an act of an unreasonable character in disregard of a known or obvious risk that was so great as to make it highly probable that harm would follow and has done so with conscious indifference to the outcome.

On the part of Seller's Managerial or Senior Supervisory Personnel, an intentional and wrongful act, or an intentional and wrongful omission of some act, in either case with the intent to inflict damage or injury.

"Gross Negligence"



"Willful Misconduct"

GC.2 REPRESENTATIONS

Contractor hereby represents that it has made the necessary commitment, that it possesses the necessary professional capabilities, qualifications, licenses, skilled personnel, experience, expertise and financial resources, and that it has available or will make available the necessary equipment, materials, supplies, tools, facilities and services to perform the Work in an efficient workmanship and timely manner in accordance with the terms and conditions of this Contract.

Contractor further represents that this Contract is entered into without the assistance or intervention, direct or indirect, of any broker, intermediary, commission agent or any similar person, firm or corporation, whether Saudi Arabian or non-Saudi Arabian, except the duly licensed agent of Contractor in the Kingdom where required by law, and that Contractor has not engaged the services of such agent for the purposes of exercising or obtaining improper influence; and Contractor represents that it has the right to perform the Work free of any right, title or interest of, or any obligation to, or undertaking arrangement with, any third party, except as expressly provided in this Contract.

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GC.3 INDEPENDENT CONTRACTOR

In performing the Work, Contractor shall act as an Independent Contractor and not as the agent of MARAFIQ maintaining complete control over its employees and representatives. All persons employed by Contractor in connection with this Contract shall be its employees and not employees of MARAFIQ. Contractor shall perform the Work in accordance with its own methods subject to compliance with the terms and conditions of this Contract.

If Contractor is a partnership, joint venture or consortium, then for the purpose of this Contract each member of such partnership, joint venture or consortium shall be jointly and severally liable hereunder notwithstanding any Contract as between themselves to the contrary.

GC.4 STANDARD OF PERFORMANCE

Contractor shall perform the Work in accordance with OEM practices professional standards of skill, quality, care and diligence adhered to by recognized first-class international firms performing services of a similar nature and in performing the Work shall consider the use of the latest proven and tested methods known to and successfully employed by such firms. Contractor shall guarantee and be responsible for the professional quality, timeliness, co-ordination and completeness of the Work, and is hereby given notice for the purposes of establishing liability hereunder that MARAFIQ will be relying upon such quality, timeliness and co-ordination in Contractor's implementation of the Contract/Project.

GC.5 LAWS AND REGULATIONS

This Contract shall be subject to, governed and construed, in accordance with the laws and regulations in force in the Kingdom of Saudi Arabia.

Contractor acknowledges that the laws, decrees, decisions, ordinances, statutes, regulations, rules and traditions and customs of the Kingdom of Saudi Arabia and any political subdivision or public authority thereof, including, without limitation, tax, tariff, safety, labor, environmental, security and social security laws and regulations, shall at all times apply to Contractor and its employees and representatives in the implementation of this Contract.

Provided nothing herein shall require seller to commit breach of US Export Control & Economic Sanctions Law.

In addition, all personnel rules, plant rules, safety rules and other rules and instructions of MARAFIQ shall apply to Contractor and its employees and representatives and Contractor shall perform the Work hereunder in such a manner as to avoid endangering the safety or unlawfully interfering with the convenience of the public or the property and employees of MARAFIQ.

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If any discrepancy or inconsistency should be discovered between this Contract and any such law, decision, ordinance, regulation order or decree, Contractor shall immediately report the same in writing to MARAFIQ.

Should the Contractor at any time throughout the term of the Contract willfully or negligently fail to comply with the above requirements, MARAFIQ will have the right to terminate the Contract with no remedy whatsoever available to the Contractor against MARAFIQ.

If any discrepancy or inconsistency should be discovered by MARAFIQ between this Contract and any such law, decision, ordinance, regulation order or decree, MARAFIQ may inform contractor acting reasonably.

GC.6 IMPORTATION AND CUSTOM DUTIES

In connection with the performance of this Contract, Contractor acknowledges that the import and customs laws and regulations of the Kingdom of Saudi Arabia shall apply to the furnishing and shipment of any product or components thereof to or from the Kingdom of Saudi Arabia including the regulations prohibiting importation of certain materials.

Contractor shall comply with Applicable Legal Requirements regarding:

any customs duties payable by it in connection with the furnishing and shipment of any Goods to or from The Kingdom;

any exemptions from customs duties available in relation to any imported Goods that are not manufactured in The Kingdom.

Contractor shall consign all imported Goods to MARAFIQ and provide MARAFIQ with a list of all such imported Goods upon placement of purchase orders with foreign suppliers. Consignment of the Goods in the name of MARAFIQ shall not relieve Contractor of its responsibility for customs clearance or its other obligations under this Contract.

Contractor shall provide to the applicable customs authorities in The Kingdom all such documentation as shall be required under Applicable Legal Requirements for the clearance of all shipments to The Kingdom including, among other things, the following documents:

the original customs declaration (Bayan);

a certificate of origin;

the relevant commercial invoices and an Arabic translation thereof, as applicable; and

proof of payment to foreign suppliers.

MARAFIQ shall, at Contractor's request, attest the existence of a valid contract between MARAFIQ and Contractor as and when required.

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Contractor shall pay all applicable customs duties under deposit. MARAFIQ shall subsequently, at its sole discretion, use commercially reasonable efforts to claim a refund of such customs duties as are eligible for the exemptions referred to in Clause GC.6(a)(ii) (Importation and Customs Duties).

Where MARAFIQ elects to claim a refund under Clause GC.6(d) (Importation and Customs Duties) above in accordance with Applicable Legal Requirements, Contractor shall undertake all such acts or things as shall be necessary to enable MARAFIQ to claim such refund, including, among other things, submitting to MARAFIQ, immediately following the clearance of the relevant Goods, the documents listed in Clause GC.6(c)(i) to GC.6(c)(iv) (Importation and Customs Duties) above, as applicable.

MARAFIQ shall be entitled to set-off the amounts of any customs duty exemptions or refunds due which MARAFIQ fails to recover as a result of Contractor's failure to comply with the requirements of this Clause GC.6 (Importation and Customs Duties) from any payments due to Contractor under this Contract.

Contractor shall procure that all subcontractors comply with the obligations set out in this Clause GC.6 (Importation and Customs Duties) where applicable.

GC.7 PERMITS

Except as otherwise provided herein, Contractor shall procure and pay for all permits, licenses, authorizations, registrations and inspections and shall furnish any bonds, security or deposits required for performing the Work. In addition, Contractor shall assist MARAFIQ in obtaining any permits or authorizations necessary for the performance or implementation of the Work which permits or authorizations must formally be issued in the name of MARAFIQ.

GC.8 CONFIDENTIALITY

Contractor shall not, without the prior written consent of MARAFIQ, disclose or make available to any person, other than MARAFIQ, or use, directly or indirectly, except for the performance and implementation of the Work, any confidential information (as hereinafter defined) in connection with the performance of this Contract, unless: (i) The information is known to Contractor (as evidenced by its written records) prior to obtaining the same and is not otherwise subject to disclosure restrictions on Contractor; (ii) The information is in the public domain prior to the time of disclosure by Contractor; or (iii) The information is disclosed to Contractor by a third party who did receive the same, directly or indirectly, from an information holder and who has no obligation of secrecy with respect thereto.

As used herein, the term "Confidential Information" shall mean any information whether written, soft copy and/or oral, concerning Power and Water Utility Services in Jubail and Yanbu Industrial Cities, relating to or consisting of processes, techniques, procedures, designs, drawings, plans, diagrams and other technical data, information, policies and contracts including this Contract.

Seller and Buyer (as to information disclosed, the "Disclosing Party") may each provide the other party to information received, the "Receiving Party") with Confidential Information in connection vi

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Contract. "Confidential Information" means (a) information that is designated in writing as "confidential" or "proprietary" by Disclosing Party at the time of written disclosure, and (b) information that is orally designated as "confidential" or "proprietary" by Disclosing Party at the time of oral or visual disclosure and is confirmed to be "confidential" or "proprietary" in writing within twenty (20) days after the oral or visual In addition, prices for Products and Services shall be considered Seller's Confidential Information.

Receiving Party agrees: (i) to use the Confidential Information only in connection with the Contract and use of Products and Services, (ii) to take reasonable measures to prevent disclosure of the Confidential Information to third parties, and (iii) not to disclose the Confidential Information to a competitor of Disclosing Party. Notwithstanding these restrictions, (a) Seller may disclose Confidential Information to its affiliates and subcontractors in connection with performance of the Contract, (b) a Receiving Party may disclose Confidential Information to its auditors, (c) Buyer may disclose Confidential Information to lenders as necessary for Buyer to secure or retain financing needed to perform its obligations under the Contract, and (d) a Receiving Party may disclose Confidential Information to any other third party with the prior written permission of Disclosing Party, and in each case, only so long as the Receiving Party obtains a non-disclosure commitment from any such subcontractors, auditors, lenders or other permitted third party that prohibits disclosure of the Confidential Information and provided further that the Receiving Party remains responsible for any unauthorized use or disclosure of the Confidential Information. Receiving Party shall upon request return to Disclosing Party or destroy all copies of Confidential Information except to the extent that a specific provision of the Contract entitles Receiving Party to retain an item of Confidential Information. Seller may also retain one archive copy of Buyer's Confidential Information.

The obligations under this Article 6 shall not apply to any portion of the Confidential Information that: (i) is or becomes generally available to the public other than as a result of disclosure by Receiving Party, its representatives or its affiliates; (ii) is or becomes available to Receiving Party on a non-confidential basis from a source other than Disclosing Party when the source is not, to the best of Receiving Party's knowledge, subject to a confidentiality obligation to Disclosing Party; (iii) is independently developed by Receiving Party, its representatives or affiliates, without reference to the Confidential Information; (iv) is required to be disclosed by law or valid legal process provided that the Receiving Party intending to make disclosure in response to such requirements or process shall promptly notify the Disclosing Party in advance of such disclosure and reasonably cooperate in attempts to maintain the confidentiality of the Confidential Information.

Each Disclosing Party warrants that it has the right to disclose the information that it discloses. Neither Buyer nor Seller shall make any public announcement about the Contract without prior written approval of the other party. As to any individual item of Confidential Information, the restrictions under this Article shall expire five (5) years after the date of disclosure. Article 6 does not supersede any separate confidentiality or nondisclosure agreement signed by the parties.

Contractor further agrees that it shall not make any announcements or release any information or SaidM CLECTRIC WITE WO photographs concerning this Contract or any part thereof to any member of the public or the press or an official body unless prior written consent is obtained from MARAFIQ

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Contractor shall take all steps which may be necessary or appropriate in order that its employees, representatives and agents adhere to the provisions of this confidentiality obligation pursuant to the performance of this Contract.

Notwithstanding Contractor's taking such steps or including such clauses as required hereunder, Contractor shall remain liable for any failure or refusal of any of his employees, representatives and agents to comply with this General Condition.

GC.9 LIABILITY, INDEMNITY AND RELEASE

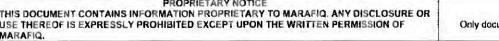
- 101022331 9.1 Contractor shall be liable for, and shall indemnify, defend, save harmless and release MARAFIO and its authorized representatives and each of them and all of their employees, officers, directors and representative from and against, any and all losses in respect of injuries or damage to any person or property, suits, actions, legal or administrative proceedings, claims, demands, damages, liabilities, interest, attorney's fees, costs and expenses of whatsoever kind or nature, whether arising before or after completion of the Work, which are in any manner directly caused, occasioned or contributed to in whole or in part by reason of any failure, or failure, to comply with the provisions of this Contract, any inaccuracy in the representations of Contractor hereunder or any act, omission, strict liability, fault or negligence, whether active or passive, of Contractor or of any one acting under its direction, control or on its behalf in connection with or arising out of the performance of this Contract, whether or not caused in part by a party indemnified, held harmless or released hereunder. Without limiting the generality of the foregoing, the same shall include injury to or death of any person or persons and damage to any property, regardless of where located, including without limitation the property of the MARAFIQ, its authorized representatives, Contractor, Contractor's employees and all other persons. Contractor's aggregate total liability under this contract shall be limited to a maximum of the final total contract price. Moreover, Contractor's aforesaid indemnity, hold harmless and release obligations, and direct liability to MARAFIQ, shall not be applicable with respect to any losses caused by the sole active negligence or willful misconduct of a party indemnified, held harmless or released hereunder, except to the extent that Contractor shall have had the opportunity to prevent or reduce such losses and shall have negligently or willfully failed to do so.
- Except as specifically provided for in Attachment C Contractor shall not be liable to MARAFIQ and 9.2 nor shall MARAFIQ be liable to Contractor, for any consequential or indirect loss and/or damage including for loss of profits, loss of use of products or services or interruption of business or for any other special, incidental or indirect damage, resulting from performance, non-performance or delay in the performance of its obligations under this contract.
- 9.3 Notwithstanding 9.2 above Contractor shall be responsible for direct damages resulting from any faults in the designs and specifications prepared by him under the Scope of Works. The approval of MARAFIQ of such designs and specifications shall not relieve the Contractor from his responsibility.
- Contractor shall bear all consequences resulting from claims raised by others against his breach of 950 9.4 any right, concession, design or trademark.

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GC.10 CONTRACT INTERPRETATION AND SETTLEMENT OF DISPUTES

All claims of Contractor, all questions of Contractor concerning interpretation or clarification of this Contract or the acceptable performance of this Contract and all questions of Contractor as to compensation and extension of time shall be submitted, within any period of time as specified herein or, if no such period is specified, within a reasonable period after such claim or question arises in writing to MARAFIQ for determination. MARAFIQ shall respond in writing within a reasonable period of time, and all determinations, instructions and clarifications of MARAFIQ shall be final, unless Contractor files with MARAFIQ, within fourteen (14) days after Contractor receives from MARAFIQ written notice of any such determination, instruction or clarification, a written protest, stating clearly and in detail the basis thereof and within a reasonable period of time, MARAFIQ will issue a decision in writing upon each such protest. Contractor's failure to file such protest within the fourteen (14) day-period shall constitute a waiver by Contractor of all its rights to further protest to MARAFIQ or otherwise.

MARAFIQ decision upon such protest shall be final, unless within thirty (30) days after Contractor receives from MARAFIQ written notice thereof, Contractor disputes such decision by sending written notice to MARAFIQ. If Contractor disputes such decision as aforesaid or if MARAFIQ has an unresolved claim against the Contractor, the parties together shall make in good faith efforts to resolve such dispute or claim by whatever means they deem appropriate including conciliation and seeking the assistance of technical, accounting or other experts. Any dispute or claim, which the parties are unable to resolve within a reasonable time after such efforts shall be referred to the appropriate Court of Law in the Kingdom of Saudi Arabia for final determination, and Contractor hereby consents to the exclusive jurisdiction of the Court of Law in the Kingdom of Saudi Arabia for the purpose of final determination of any such dispute or claim arising hereunder.

Notwithstanding any such protest, dispute claims, settlement effort or court proceedings relating directly or indirectly to this Contract at all times, Contractor shall proceed with the performance of the Work accordance with the determination, instructions and clarification of MARAFIQ.

GC.11 CONTRACT DOCUMENTS

Except as otherwise provided herein, the provisions of Attachment "A", Attachment "B" and Attachment "C" hereof shall prevail over those of any other documents forming part of this Contract. Subject to the foregoing, the several documents forming the Contract are intended to be correlative and mutually explanatory, and any Work required in one document and not mentioned in another shall be performed to the same extent and purpose as though required by all. The misplacement, addition or omission of a Work or character shall not change the intent of any part of the Contract from that set forth by the Contract as a whole. Contractor shall be solely responsible for requesting any interpretation or clarification of the Contract and shall bear at its own expense any costs and expenses arising from its failure to do so.

If Contractor discovers any conflict, ambiguity, error, omissions or discrepancies among the various documents forming this Contract, the matter shall be submitted immediately by the Contractor in writing to MARAFIQ for clarification. Any Work affected by such conflict, ambiguity, error, omissions or discrepancies which is performed by the Contractor subsequent to discovery but prior to clarification by MARAFIQ shall be at Contractor's risk.

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MARAFIQ stresses upon strict adherence to the terms and conditions of this Contract, in so much that any instruction or communication whether oral, written or in any other form shall be considered void should it be in conflict with the terms and conditions of this Contract. It is the Contractor's sole responsibility to make aware of such instructions if any, immediately to MARAFIQ's authorized personnel.

GC.12 CONTRACTOR'S ORGANIZATION AND KEY PERSONNEL

As required by MARAFIQ, Contractor shall submit for MARAFIQ's approval an organizational chart showing the proposed organization to be committed by the Contractor for the performance of the Work, including (i) lines of authority, responsibility and communication, (ii) division of responsibilities between Contractor's Work site and off-site organizations, (iii) names, titles and functions of all supervisory and other key personnel, and (iv) the total number of non-manual personnel. In addition, if required by MARAFIQ, Contractor shall submit detailed resume (original or copies of supporting documentation) which may be subsequently requested by MARAFIQ of the professional qualifications of each person proposed to occupy a position deemed by MARAFIQ to be significant within the organizational structure. Upon the approval of such organizational chart and proposed personnel by MARAFIQ, no changes shall be made without MARAFIQ's prior written approval.

Contractor's key personnel assigned for the performance of the Work shall not be reassigned without MARAFIQ's prior written approval and until a satisfactory replacement has been approved by MARAFIQ. Such written approval shall not be unreasonably withheld.

Before commencing Work hereunder, Contractor shall appoint a competent, English speaking Project Manager acceptable to MARAFIQ to represent and act for Contractor at all times during the performance of the Work and shall inform MARAFIQ in writing of his address and telephone number and of the scope of his authority and of any and all limitations on such authority. Upon the approval of such Project Manager, no change shall be made without MARAFIQ's prior written consent. Such Project Manager shall have overall responsibility for the Work and shall be present at the Work-site during such periods as MARAFIQ may designate. All notices, determinations, instructions and other communications given to such Project Manager by MARAFIQ shall be binding upon Contractor.

The Contractor understands that the current organizational chart may be changed at the request of MARAFIQ to fit in developing changes.

GC.13 AUTHORIZED REPRESENTATIVE

MARAFIQ may designate by written notice to Contractor or by provision elsewhere in this Contract at east one or possibly more persons, firms or corporations to act as authorized representative in connection with the administration of this Contract except as otherwise provided in such written notice or elsewhere herein. Such authorized representative shall have the authority to act for MARAFIQ with respect to the performance of this Contract by Contractor with the objective of achieving full compliance by the Contractor with the terms and provisions of this Contract. Contractor shall accept and comply with instructions from such authorized representative as though such instruction has been given by MARAFIQ and Contractor shall deal directly with such authorized representative in all manners arising under this

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Contract, to the extent of Performance of Works under this Contract and (WORKSCOPE SECTION to matters involving Contract interpretation, disputes and submissions for MARAFIQ's approval. However, such authorized representative is authorized to act in connection with this Contract solely as the representative of MARAFIQ and not as principal hereunder.

GC.14 SPECIFICATIONS AND DATA FURNISHED BY MARAFIQ

MARAFIQ may furnish the Contractor, as a part of this Contract, specifications, MARAFIQ's Safety Policy and Procedures Manual and other technical data and information detailing and describing the Work. Contractor shall verify and check all such specifications, data and information and shall promptly notify MARAFIQ of any errors, omissions or discrepancies. Errors or omissions in such specifications, data and information or the description of Work which are necessary to carry out the intent thereof, or which is customarily performed, shall not relieve Contractor from performing such omitted or incorrectly described Work, but such Work shall be performed by Contractor as if fully and correctly set forth and described therein. Contractor shall obtain approval from MARAFIQ for any deviation from such specifications, data or information prior to incorporating such deviation into the Work.

GC.15 LOCAL CONDITIONS

Contractor shall have the sole responsibility for, and has investigated and satisfied himself concerning the nature and location of all places and facilities where the Work shall be performed and the general local conditions in the Kingdom and particularly, but without limitation, with respect to the following: those affecting shipping and transportation, port facilities, port congestion, access, disposal, handling and storage of materials; availability and quality of labor, water and electric power; availability and conditions of roads and bridges, climatic conditions and seasons, physical and structural conditions including ground and subsurface conditions, equipment, materials and facilities needed preliminary to and during performance of the Contract, local laws regulations and customs, and all other matters which can in any way affect the performance of the Work or the cost associated with such performance. The failure of Contractor to acquaint himself with any applicable condition will not relieve him from the responsibility of properly estimating either the difficulties or the cost of successfully performing the Work.

Where MARAFIQ has made investigations of conditions in areas where the Work is to be performed and where the records thereof are not included as a part of this Contract, MARAFIQ may make available such records solely for the purpose of general information and for the convenience of Contractor. MARAFIQ assumes no responsibility whatsoever in respect to the sufficiency or accuracy of the investigations thus made, the records thereof, or of the interpretations set forth therein or made by MARAFIQ in its use thereof, and there is no warranty or guaranty, either express or implied, that the conditions indicated by such investigations or records thereof are representative of those existing throughout such areas, or any WHEN PLECTRICINT'S INC MANAGES part thereof, or that unforeseen developments may not occur.

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GC.16 WORK AREA AND ACCESS

Upon the execution of this Contract or within the time elsewhere provided herein, or upon the date stated in the Notice to Proceed, MARAFIQ shall make available to Contractor the Work-site. MARAFIQ will assign all Contractor's Work- areas at the Work-site and Contractor shall confine its plant and equipment to the areas so assigned. Should Contractor find it necessary or advantageous to use any additional land outside the Work-site for any purpose whatsoever, Contractor shall at its expense and with prior written approval from MARAFIQ, provide and make its own arrangements for the use of such additional land.

For the purpose of determining compliance with the requirements of this Contract, MARAFIQ shall have access, at all reasonable times, to such Work-areas and premises used by Contractor.

GC.17 MOBILIZATION AND DEMOBILIZATION

Except as otherwise provided herein, Contractor shall arrange and provide at its own expense for all mobilization and demobilization of its equipment and personnel at the Work-site, including but not limited to providing for temporary facilities, housing and accommodation, transportation, visas, residence permits, customs clearance and customs claims, work permits and all applicable licenses and authorizations and for immigration and emigration of personnel as appropriate.

GC.18 LABOUR AND PERSONNEL

Contractor shall provide and employ only competent, experienced and properly qualified personnel to perform the Work, but Contractor shall not employ any person who has resigned or been discharged from the employment of other contractors, unless otherwise approved by MARAFIQ.

Contractor shall not employ any person other than a Saudi Arabian national to perform any part of the Work in the Kingdom, whether on a temporary or permanent basis, unless such person holds a valid residence permit and work permit issued under the laws of the Kingdom.

With respect to Work performed at the Work Site, Contractor shall be responsible for maintaining labor relations and discipline in such a manner that there is harmony and order among its personnel. Contractor shall comply with and shall cooperate in enforcing MARAFIQ work site procedures and instructions which affect the performance of the Work, including but not limited to starting and quitting time, smoking rules, labor procedures, check-in and check-out procedures, Work-site safety rules and daily clean-up.

MARAFIQ shall have the right, in its absolute discretion, to require the removal of Contractor's personnel at any level assigned to the performance of the Work under this Contract inside or outside the Kingdom.

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GC.19 ASSIGNMENT OF THE CONTRACT

Contractor shall not make an assignment of this Contract or any part hereof, nor shall Contractor subcontract with any other contractor who is to perform any part of the Work at the Work-site or with any vendor who is to furnish equipment or materials fabricated to meet the specific requirement of the Work without the prior written consent of MARAFIQ. In no event will the Contractor be permitted to subcontract all of the Work. Any consent granted under this general condition should be subject to Contractor submitting to MARAFIQ the proposed assignment, or subcontract for review.

Contractor shall ensure that the terms and conditions of the proposed assignment or subcontract shall comply with and correspond to the terms and conditions of this Contract. The consent of MARAFIQ shall not relieve the Contractor or his surety of their duties and obligations under this Contract and Contractor shall continue to be responsible for the observance by any such assignee or subcontractor of the terms and conditions of this Contract. In addition, MARAFIQ shall not be liable for any delays or costs incurred by Contractor by reason of MARAFIQ not granting consent to a proposed assignee or subcontractor.

Upon execution of the assignment or subcontract, Contractor shall furnish MARAFIQ with two (2) copies of each such assignment or subcontract.

Failure by Contractor to obtain the prior written consent of MARAFIQ for the portion of the Work to be assigned or subcontracted in the name of the proposed assignee or subcontractor, or for the proposed assignment or subcontract as required by the provisions hereof, shall be cause for termination of this Contract in accordance with the provisions of the General Conditions entitled Termination for Default.

If, in the opinion of MARAFIQ, any portion of the Work being performed by an assignee or subcontractor is not performed in accordance with the terms and conditions of this Contract, the assignee or subcontractor shall be removed from the Work by the Contractor at the written request of MARAFIQ, provided, however, that any failure of MARAFIQ to make such a request shall not relieve Contractor of its obligations hereunder. In addition, MARAFIQ shall not be liable for any delays or costs incurred by Contractor by reason of the removal of an assignee or subcontractor which is not performing any portion of the Work in accordance with the terms and conditions of this Contract, whether or not such removal was requested by MARAFIQ.

The Contractor shall be jointly responsible with the assignee or the subcontractor for proper and complete implementation of the Contract.

GC.20 SAUDI ARABIAN AND GULF COOPERATION COUNCIL STATES GOODS AND SERVICES

With respect to any materials, supplies, goods, equipment or services purchased, leased, contracted for or otherwise obtained or required by Contractor in the performance of the Work, Contractor is encouraged to utilize materials, supplies, goods, equipment or services (National Products) of Saudi Arabian or Gulf Co-operation Council States of origin. In so doing, Contractor shall be bound by the Articles of the Council of Ministers Resolution No. 377 dated Rabi Thani 4, 1398 A.H. corresponding to March 12, 1978, and

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Decision No. 139 dated 25/6/1407H corresponding to February 23, 1987 issued by the Council of Ministers.

Contractor is also encouraged to use the services of Saudi Arabian Airlines for the transportation by air of all personnel and for the shipment by air of all materials and equipment necessary for or in connection with the performance of the Work, both within and outside the Kingdom. Contractor is also encouraged to employ the services of the United Arab Shipping Company or the National Shipping Company for the shipment by sea of all materials and equipment necessary for or in connection with the performance of the Work.

GC.21 INSPECTION

Seller shall apply its quality control procedures in manufacturing Products. Seller shall attempt to accommodate requests by Buyer to witness Seller's factory tests of Products, subject to appropriate access restrictions, if such witnessing can be arranged without delaying the work.

Except as expressly provided otherwise in this Contract, Contractor shall be responsible for all inspection specified in this Contract or required by law, applicable code, or sound professional practice. In addition to and without limiting Contractor's responsibility for inspection, all Work performed hereunder shall be subject at all times during performance and upon completion to review and inspection by MARAFIQ. Contractor shall provide sufficient and convenient facilities and equipment for such inspection and review by MARAFIQ and shall grant MARAFIQ duly designated representatives free access at all reasonable times to Contractor's offices, work areas and all other locations where the Work is being performed.

MARAFIQ shall have the right to reject any part of the Work than are found defective or not in conformity with the requirements of this Contract, whereupon such rejected Work shall be satisfactorily corrected, re-performed or replaced at Contractor's expense.

If unsatisfactory Work re-performed by Contractor does not meet the requirements specified in the Contract and if the defect is such that it cannot be corrected by further re-performance, then MARAFIQ shall have the right to reduce the amount payable under the Contract to reflect the reduced value of the completed Works.

The amount for the above deductions, if applicable, shall be separate from the Damages Clause specified in Attachment "C".

Neither MARAFIQ inspection of or failure to inspect, nor approval or acceptance of, or payment for the Work, shall prejudice any rights of MARAFIQ under this Contract or of any cause of action arising out of the performance of this Contract, and Contractor shall remain liable to MARAFIQ in accordance with this Contract and all applicable laws for all damages to MARAFIQ caused by any failure of Contractor to comply with the terms and conditions of this Contract. 145

Within sixty (60) days after the date of this Contract, Contractor shall submit to MARAFIQ for review approval of a quality assurance plan covering all Work whether at the Work-site or elsewhere. The plan covering all work whether at the Work-site or elsewhere. shall be in two parts covering off-work site and on-work site activities respectively. The quality is all



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procedures shall include, but not limited to, a detailed description of each item or part of the Work to be inspected, the nature and frequency of the inspection, the type and size of samples to be taken, if any, the means of recording the inspection data, the name and specific responsibility of any proposed inspection agency and all other information necessary or required to fully describe the inspection to be performed for the Work. Contractor's quality assurance procedures as approved or modified by MARAFIQ shall be used for the inspection of the Work and shall be revised and resubmitted for MARAFIQ's approval if Contractor desired to change the sequence, method or nature of the inspection if it is not in accordance with the current approved Contract Schedule and Scope of Work. Neither MARAFIQ approval nor failure to approve Contractor's inspection plan shall relieve Contractor of its responsibility for the inspection and performance of the Work as provided for in this Contract.

GC.22 MATERIALS, PLANT, TEMPORARY WORKS AND CONTRACTOR'S EQUIPMENT

Except as otherwise provided herein, Contractor shall furnish and be responsible for all Material, Plant, Temporary Works, Contractor's Equipment, services and supplies required to perform the Work. Such items shall be capable of producing the quality and quantity of Work and materials required by the Contract within the time or times specified in the Contract. Such responsibility shall include but not limited to procurement, expediting, shipment, customs clearances, loading, handling and all transportation and storage in the Kingdom. Contractor shall also be responsible at its expense for all necessary import and export licenses, handling charges, custom duties (subject to Article GC.6 Importation and Customs Laws), port duties, surcharges, landing and other charges in connection with shipment to and from the Kingdom before proceeding with the shipment to the Work-site of any plant or with erection at the Work-site of any facilities, including but not limited to temporary structures, machinery, equipment, offices, shops and warehouses. Contractor shall at its expense furnish MARAFIQ with such information relative thereto as MARAFIQ may request. Thereafter, upon written order of MARAFIQ, Contractor shall discontinue operation of any unsatisfactory plant previously admitted to the Work site and shall either modify the unsatisfactory items to meet MARAFIQ's approval or remove the unsatisfactory items from the Work-site.

Prior to removal of any or all of Contractor's Equipment from the Work-site, Contractor shall get clearance from MARAFIQ for such removal; No plant and equipment shall be removed from the Work-site without prior approval from MARAFIQ.

Contractor shall ensure that each item of mobile Contractor's Equipment located at the Work-site is clearly identified with the name of the Contractor and project and a number assigned by Contractor. Such identification shall be at least Fifteen (15) centimeters in height and shall be placed on opposite sides of such item. Contractor shall not use, and shall remove from the Work-site, improperly identified plant

GC.23 MARAFIQ PROPERTY

MARAFIQ shall furnish or make available to Contractor all MARAFIQ Property, provided only such property is in accordance with the provision of this Contract. Upon delivery or transfer of any MARAFIQ Property to Contractor, MARAFIQ and Contractor shall prepare and sign an inventory of such property which shall be considered as an integral part of this Contract and which shall set forth in detail the condition of each such item of MARAFIQ Property and any specific limitations on Contractor's use and

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custody thereof. Thereafter, Contractor shall use such property only for purposes directly relating to the performance of the Work and shall be fully responsible for the preservation, protection and maintenance and if repair is necessary, Contractor shall coordinate with MARAFIQ for the repair of the property as long as it is in Contractor's possession. In addition, Contractor shall not make any alterations to MARAFIQ's Property without the prior written consent of MARAFIQ. Upon completion of the Work by Contractor or termination by MARAFIQ and before final payment is made, Contractor shall surrender or return to MARAFIQ all MARAFIQ Property in Contractor's possession in the same condition as described in the aforementioned inventory with reasonable wear and tear expected. Notwithstanding such responsibilities of Contractor, title to all MARAFIQ's Property shall vest at all time with MARAFIQ, and the same shall not be affected by the fact that such property is incorporated into or attached to property not owned by MARAFIQ.

In case of the loss or destruction of, or damage to any MARAFIQ's Property in Contractor's possession from any cause whatsoever, Contractor shall:

- a) Promptly notify MARAFIQ;
- b) Take all reasonable steps to protect such MARAFIQ's Property from further loss or damage;
- Promptly take action in coordination with MARAFIQ for the repair, renovation or replacement of such MARAFIQ's Property in accordance with MARAFIQ's instructions; and
- Take other actions with respect to such property as MARAFIQ shall direct.

The reasonable cost of any such repair, renovation or replacement shall be at MARAFIQ's expense, except for the cost of any repair, renovation, replacement or other action with respect to MARAFIQ's Property necessitated by loss, destruction or damage caused in part or in whole by the negligence or misconduct of Contractor, its employees or representatives, which shall be at Contractor's expense. Contractor shall do nothing to prejudice the rights of MARAFIQ to recover against third parties for any loss or destruction of, or damage to MARAFIQ's Property caused by such third parties and, upon request, shall provide MARAFIQ all reasonable assistance, evidences and cooperation in obtaining such recovery, including, without limitation, prosecution of any appropriate action and the execution of instruments of assignment in favor of MARAFIQ.

The provisions and requirements of this General Condition shall not be construed as limiting or restricting but shall be in addition to any and all other provisions of this Contract relating to MARAFIQ's Property.

GC.24 DELIVERY, UNLOADING AND STORAGE

Except as otherwise provided herein, Contractor shall deliver to the Work-site, receive, unload, store in a secure place, and deliver from storage to the Work-area all plant, supplies and equipment required for the performance of the Work at the Work-site. Contractor's storage facilities and methods of storing shall meet MARAFIQ's approval.

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Contractor shall keep for MARAFIQ's inspection complete and accurate records of all plant, supplies and equipment received at the Work-site, stored, and issued for use in the performance of the Work.

All such stored plants, supplies and equipment that require on-going routine servicing or maintenance as may be defined by MARAFIQ or supplier or recognized common practice while in storage shall be the responsibility of the Contractor.

Risk of Loss; Deliveries; Title Transfer; Storage

Risk of loss shall pass to MARAFIQ upon Initial Acceptance.

For all shipments, Contractor "GE" shall deliver Products to MARAFIQ DDP Yanbu, Saudi Arabia (Incoterms 2010). Partial deliveries are permitted. Contractor may deliver Products in Advance of the delivery schedule. Title to Products shall pass to MARAFIQ upon delivery DDP Yanbu, Saudi Arabia (Incoterms 2010), except for shipments from the U.S. to another country, title shall pass to MARAFIQ immediately after each item departs from the territorial land, seas and overlaying airspace of the U.S.

If any products to be delivered under this contract cannot be shipped to or received by MARAFIQ when ready due to any cause attributable to MARAFIQ or its other contractors, Contractor may ship the Products and equipment to a designated or temporary storage facility.

GE will also provide a Parent Company Guarantee to cover for delivered Parts Risk of Loss and damage until Initial acceptance of each of the GTG's.

GC.25 SAFETY

- 25.1 Contractor shall at all times conduct its operations at all locations where the Work is performed in such a manner as to avoid any risk of bodily harm to persons or damage to property. Contractor shall promptly take all precautions, which are reasonable or necessary to safeguard against such risks, and shall make regular safety inspections of the conditions where the Work is performed, and any materials or equipment used in the performance of the Work. Contractor shall be solely responsible for the discovery, determination and correction of any unsafe conditions arising in connection with the performance of the Work.
- 25.2 In addition, Contractor shall comply with all applicable safety laws, standards, codes and regulations of the Kingdom of Saudi Arabia, including Saudi Labor law, all Safety Procedures & Program established by MARAFIQ. Contractor shall cooperate and co-ordinate with other Contractors on safety matters and shall promptly comply with all specific safety instructions or directions given to Contractor by MARAFIQ.
- 25.3 Contractor's employees or Sub-Contractor's employees shall undergo Safety Induction Training Program conducted by MARAFIQ prior to entry to MARAFIQ's facilities.

In addition Contractor's Safety Representative shall be required to have attended a course Life Support (BLS), which course shall be approved by the MARAFIQ clinic.

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- 25.4 If not approved prior to the award of this Contract, Contractor shall, within thirty (30) days of the effective date of the Contract, submit a written Safety & Fire Prevention Plan to MARAFIQ's Loss Prevention Division. Contractor shall execute the Work in strict compliance with the Safety & Fire Prevention Plan as approved by MARAFIQ. This Safety & Fire Prevention Plan incorporates as necessary MARAFIQ's issued Safety Policy, Procedures, standing instructions and shall include precautions for all types of hot works, aimed at ensuring there are no fire, personal harm and property damage resulting from such Work, either during or subsequent to such Work being undertaken.
- 25.5 Contractor shall submit a Safety Action Plan to MARAFIQ's Loss Prevention Division for approval. This plan shall cover, but not be limited to, specific objectives & targets to achieve the long term safety objectives such as procedures to be written or reviewed, safety training requirements, frequency of safety meetings, frequency of inspections & audits and frequency of contingency plan rehearsals involving own and external resources, and shall include evidence of a contract with a local Hospital to provide an ambulance and medical services when needed in emergency; subject to the provisions of Article GC 29 below.
- 25.6 Such safety regulations & procedures may be updated from time to time at MARAFIQ's discretion and Contractor shall comply with such updates as directed by MARAFIQ's representative. Contractor shall comply with MARAFIQ's requirements for occupational health and industrial hygiene. Changes thereto will be advised to Contractor, provided, however, that MARAFIQ's approval of any such plan shall not relieve Contractor of its other obligations hereunder.
- 25.7 Contractor will not be allowed access to MARAFIQ's facilities until a Safety & Fire Prevention Plan has been approved by MARAFIQ. Contractor shall inform its employees of safety practices and the requirements of any of MARAFIQ and Contractor's safety plans. Contractor shall furnish suitable safety equipment and enforce the use of such equipment by its employees.
- 25.8 Contractor's Safety Representative is responsible for the safe performance of Work at the Work Site. Within ten (10) days from the Effective Date of this Contract, but not later than the Commencement Date as indicated in the Notice to Proceed (NTP), Contractor shall advise MARAFIQ in writing of its safety representative who will be the focal point for matters relating to Safety, Occupational Health and Industrial Hygiene and to whom communications on such matters shall be addressed. Contractor's Safety Representative shall be interviewed by MARAFIQ's Loss Prevention Division for evaluation & approval of his competency before being on site, who shall ensure that the MARAFIQ clinic has approved in writing that the Contractor's Safety Representative has attended an approved course in Basic Life Support.
- 25.9 All Contractors' personnel shall be required to attend prescribed safety courses. The course will cover Rules and Regulations for Safety, Security and Fire Prevention. Course(s) will be arranged by MARAFIQ at no cost to Contractor. The associated cost of Contractor's personnel attending the course(s), shall, however, be for Contractor's account.

Contractor shall give 48 hours advance notice to MARAFIQ's Loss Prevention Representative of the names and number of its employees who will attend each course.

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25.10 In the event of failure of the Contractor to comply with any of the requirements set forth herein, MARAFIQ shall have authority to stop any operations of Contractor affected by such failure until the condition is remedied. All time lost due to any such stop order shall be the burden of Contractor and shall not be recorded as working hours and not subject of a claim for increased costs or damages by Contractor.

GC.26 PROTECTIVE CLOTHING AND SAFETY EQUIPMENT

Contractor shall provide and ensure that its employees use such protective clothing and safety equipment as is necessary to minimize the risk of health hazards or injury. All safety items including, but not limited to, safety shoes, gum boots, overalls, raincoats, umbrellas, uniforms, working and welding gloves, helmets, safety goggles, self-contained breathing apparatus (SCBA), safety harnesses, ropes, electrical gloves of adequate insulation and respiratory protection equipment shall be distributed by Contractor to its employees. All items shall be of good quality and shall be approved by MARAFIQ.

Contractor shall furnish, at its own expense, good quality uniforms or overalls for each of its employees of such color and pattern as will easily distinguish them from MARAFIQ's and other contractors' personnel. Contractor's name, Contract No. and Contract Description shall be clearly stenciled on the back of their uniforms. The identification and selection of color should be approved by MARAFIQ. Contractor shall ensure that employees use such uniforms and overalls.

GC.27 SAFETY, ENVIRONMENT, PUBLIC & OCCUPATIONAL HEALTH HAZARD

Contractor shall be responsible for ensuring that the project is carried out in such a way as to guarantee to the maximum extent possible, the safety of all Contractor's employees and all other parties who may be involved or affected by Contractor's operations. Contractor shall comply with all fire regulations, laws, and with MARAFIQ directives and guidelines concerning safety such as heavy lifts regulation, etc. Contractor shall regularly consult with MARAFIQ Industrial Security and Safety Departments and promptly comply with the MARAFIQ safety and security requirements and recommendations. Contractor shall approach MARAFIQ Safety Department for consultations and to obtain MARAFIQ Safety Procedures.

27.1 Asbestos: All personnel involved in cutting or handling asbestos cement pipe previously installed at the Work-site should wear appropriate clothing and respiratory mask or equipment for protection.

27.2 ENVIRONMENT

Contractor shall comply with MARAFIQ's Environmental Management System (EMS) based on ISO 14001 International Standards. This includes adherence to MARAFIQ Environmental Policy, Planning, Operation and Implementation, Checking and Corrective Action and Management Review.

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The MARAFIQ EMS incorporates all environmental systems and procedures, environmental legal requirements and other requirements to which MARAFIQ subscribes to. The Contractor shall familiarize himself and his employees with these requirements prior to commencing its works.

In addition, Contractor shall also comply, adhere and abide by the Royal Commission Environmental Regulation (currently RCER 2010) as may be applicable.

27.3 PUBLIC AND OCCUPATIONAL HEALTH

Contractor shall comply with the provisions of MARAFIQ's Public Health Code and Occupational Health Code or additional written instructions. Copies of codes will be made available from the Health Services Department.

Contractor shall likewise comply with MARAFIQ Occupational Health and Safety Management System based on OHSAS 18001 International Standards. The MARAFIQ OHSAS incorporates all systems and procedures, legal requirements and other requirements to which MARAFIQ subscribes. The Contractor shall familiarize himself and his employees with these requirements prior to commencing its works. In complying with OHSAS 18001, the following table shall be complied with by Contractor's employees:

Contractor Employees					
Exposed to low risk	Contract duration up to 3 yrs.	Normal periodic Medical checkup same as approved for MARAFIQ employees every 3 yrs.			
Exposed to low risk	Contract duration less than 3 yrs.	No need for the check up			
Exposed to high risk	Any period (to be as per contractor exposure to high risk)	Special checkup based on the type of hazards exposed with regular monitoring for +ve results			

27.4 Contractor shall:

- Submit a Job Safety Analysis for all the activities under execution.
- ii. Submit an Emergency Response Plan.
- iii. Conduct minimum of one (1) drill during the construction period.
- Furnish evidence of a contract with a local Hospital to provide an ambulance and medical services when needed in emergency by the Contractor, subject to the provisions of Article GC 29.

27.5 ACCIDENT RECORDS

Contractor and its subcontractor shall follow MARAFIQ's prescribed incident reporting procedure. All injuries sustained by Contractor's personnel or others while working on MARAFIQ's Work-site shall be reported in writing on the prescribed form to MARAFIQ's Loss Prevention Division as soon as possible, but not later than twenty-four (24) hours of the occurrence of the incident. In cases of serious injuries, MARAFIQ's Loss Prevention Representative and the Police Authority should also be informed. Contractor shall be responsible for reporting to the Labour Office all incidents and injuries as required under the rules and regulations of the Kingdom of Saudi Arabia.

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Contractor shall keep a record of all accidents, whether involving its employees or others. This shall include a record of any medical treatment, including minor trauma or dressings. These records shall be maintained for inspection by MARAFIQ at any time. The Contractor shall encourage his staff to follow MARAFIQ's safety procedure to create a safe working environment. If the Contractor is not abiding with MARAFIQ's Safety Rules and Regulations it will be considered a violation of contract obligation.

GC.28 SECURITY

During the performance of the Work, Contractor shall be responsible for internal security and protection of all plants and equipment. Contractor shall provide at its expense a lockable storage for all portable tools, equipment and materials required or to be used in the performance of the Work.

Within thirty (30) days after the Commencement Date specified in this Contract, Contractor shall submit to MARAFIQ its security program in the Work-site for approval, provided, however, that MARAFIQ's approval of any such program shall not relieve Contractor of its other obligations hereunder.

Upon the failure of Contractor to comply with any of the requirements set forth herein, MARAFIQ shall have the right to stop the Work or any part thereof until Contractor does so comply. If necessary MARAFIQ shall be entitled to bring in suitable qualified contractors to complete the Work. All time lost due to any such stop order shall be borne by the Contractor and shall not be recorded as working hours and shall not form the subject of a Contractor's claim against MARAFIQ for increased costs or damages.

GC.29 FIRST AID FACILITIES

Contractor shall be responsible for the provision of adequate First-Aid facilities at the Work-site for all personnel employed or retained by Contractor or his Subcontractor, in the performance of the Work.

- 29.1 In the case of a Contractor having up to 50 employees on site; the Contractor shall provide, on site, at least one person fully trained as a provider of First Aid.
- 29.2 In the case of a Contractor having between 50 to 300 employees on site; the Contractor shall provide, in addition to the First Aid facilities listed in GC 29.1, a nurse permanently on site during hours of working with appropriate treatment facilities. For any EPC/Construction contract with between 50 and 300 employees on site, the Contractor shall provide, in addition to the First Aid facilities listed in GC 29.1, a qualified medical doctor with appropriate treatment facilities, and an ambulance with driver and nurse, permanently on site during hours of working.
- 29.3 In the case of a Contractor having more than 300 employees on site, with a contract duration of 1 year or more, the contactor shall provide, in addition to the First Aid facilities above, a qualified medical doctor with appropriate treatment facilities, and an ambulance with driver and nurse permanently on site during hours of working.
- 29.4 In the event that the Contractor fails to provide ambulance services as outlined in b) 4 abo MARAFIQ is obliged to provide the services of an ambulance or physician for any of Contractor's

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personnel or the personnel of sub-contractor, the Contractor or its sub-contractor, shall be liable to reimburse MARAFIQ for the cost of such services at the prevailing rates, plus a penalty of 50 % of the total cost.

29.5 Contractor shall maintain medical records of all reportable industrial injuries, and a record of any medical treatment, including minor trauma or dressings. MARAFIQ's representative shall have access at all reasonable times to Contractor's records for the purpose of satisfying himself that Contractor is complying with the provisions of Article GC.28 (C). Contractor's failure to comply with the provisions of Articles GC.25, 27, 28, 30 and 31 shall constitute a substantial breach of this Contract and MARAFIQ reserves the right to terminate the Contract in accordance with Article GC.44.

GC.30 FIRE PREVENTION

Contractor shall comply with MARAFIQ's current HSE & Fire Prevention Management Plan. Contractor shall be responsible for fire prevention and fire protection practices in connection with the performance of the Work. Contractor shall not permit unauthorized fires within or adjacent to the limits of the Worksite and shall be liable for all damages from fire due directly or indirectly to its own activities or to the activities of its employees. Contractor shall instruct its personnel in their location on the use of fire extinguishers already installed at site. Contractor shall submit to MARAFIQ proof of training. All flammable materials utilized by Contractor shall be stored and used in a manner consistent with proper fire prevention measures.

At the request of MARAFIQ, Contractor shall immediately remove from the Work-site any equipment, material or structures which in MARAFIQ's judgment are contrary to MARAFIQ's fire prevention program.

Should Contractor fail to comply with any of the requirements set forth herein, MARAFIQ shall have the right to stop the Work or any part thereof until Contractor does so comply. All time lost due to any such stop order shall be the burden of Contractor and shall not be recorded as working hours and shall not be the subject of a Contractor's claim against MARAFIQ for increased costs or damages.

GC.31 WORK SITE SANITATION

Contractor shall arrange to obtain, at each of its work areas adequate waste disposal and touct facilities and potable water for the use of its employees. In addition, Contractor shall comply with all laws, standards, codes and regulations relating to sanitation at the Work-site, including MARAFIQ's requirements as to waste disposal and toilet facilities and Potable Water.

Prior to commencing Work at the Work-site, Contractor shall submit the sanitation plan to MARAFIQ for approval, provided, however, that MARAFIQ's approval of any such plan shall not relieve Contractor of its other obligations hereunder. Contractor shall provide its employees with all necessary instructions as to the use of sanitation facilities at the Work-site, and shall take all other steps which may be necessary order that its employees utilize such facilities.

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Should Contractor fail to comply with any of the requirements set forth herein, MARAFIQ shall have the right to stop the Work or any part thereof until Contractor does so comply. All time lost due to any such stop order shall be the burden of Contractor and shall not be recorded as working hours and not subject of a Contractor's claim against MARAFIQ for increased costs or damages.

GC.32 POLLUTION

Contractor shall not release, or permit to be released, into the air or any Wadi, stream, sea or other body of water at or in the vicinity of the Jubail or Yanbu Industrial City any noxious effluent or substance harmful to human, animal or plant life.

Also, Contractor is responsible to dispose of toxic wastes, pollutants, used oils and any other harmful materials to the environment in accordance with MARAFIQ and/or RC's Environmental Protection Guidelines.

In cases where Contractor will be discharging substances, discharge process should meet the minimum parameters set forth or which are allowed by environmental laws or the appropriate Government Entity.

If in any case where the Contractor violates any rules that pertains to the illegal discharge of pollution, all penalties that will be incurred shall be borne by the Contractor and shall not be subject of a Contractor's claim for increased costs or damages. Such penalties, if any, shall be in addition to the penalties and damages as mentioned in Attachment "C" of this Contract.

GC.33 ILLUMINATION

When any Work is performed at night, or where daylight is shut off or obscured. Contractor shall make the necessary arrangements to provide artificial lighting to all areas where such Work is performed and access thereto sufficient to permit such Work to be performed efficiently, satisfactorily and safely. All power sources and wiring for such artificial light shall be in coordination with MARAFIQ and shall be installed and maintained in a safe work manner-like condition and shall be in accordance with applicable codes and standards.

GC.34 COMMERCIAL ACTIVITIES

Except as provided otherwise, the Contractor shall not establish any commercial activities or issue concession licenses or permits of any kind to third parties for the establishment of commercial activities at the Work-site. Contractor shall not allow anyone of its employees to engage in any commercial activities at Work-site.

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GC.35 COOPERATION WITH OTHERS

There may be other contractors, agents or employees of MARAFIQ and its authorized representatives working at or adjacent to the Work-site during the performance of the Work by Contractor. Contractor must anticipate in its schedule and its expenses that the performance of the Work may be interfered with or temporarily delayed from time to time on account of the concurrent activities of others, and Contractor shall fully co-operate with MARAFIQ and other contractors to avoid any delay or hindrance of their activities and to assure the orderly completion and operation of the Project as a whole. MARAFIQ may also require that certain facilities and areas be used concurrently by Contractor and other persons. No extension of time for performance of the Work will be granted and no additional payment will be made to Contractor by MARAFIQ as a result of such temporary interfaces or delays arising from the activities of others at or adjacent to the Work-site.

GC.36 TAXES AND ASSESSMENTS

Contractor shall pay all taxes and assessments, including but not limited to income and franchise taxes, sales, use, excise and value added taxes, Zakat and real and personal property taxes, withholding taxes, stamp duties, fines, tariffs, custom duties and levies of every nature, due or to become due in connection with the performance of the work, and shall make any and or payroll deductions and contributions required by law or Contract.

Contractor shall defend, indemnify and hold harmless MARAFIQ and its assignees from and against all claims by government or governmental authorities and/or taxing authorities for above taxes and assessments including but not limited to those based on gross receipts and/or income of the Contractor or any subcontractor or any of their respective agents or employees with respect to any payment for the work made to or earned by Contractor or any subcontractor or any of their respective agents or employees.

GC.37 ACCOUNTING AND AUDITS

Contractor shall, at its cost and expense, keep and maintain in one place full and complete records and books of account relating to approved time and material operations, material and services procurement, if any, that are conducted in the performance of the Work in accordance with the laws of Saudi Arabia and generally accepted accounting practices. Such records and accounts shall permit Contractor to furnish MARAFIQ, upon written notice, an accurate written allocation of the total Contract Price to the various elements of the Work, as may be required by MARAFIQ.

MARAFIQ and its representatives shall at its own cost have the right to examine, upon reasonable advance notice in writing, and signing of NDA as per Appendix A to this contract, such books, records, accounts and other documents of Contractor directly pertaining to costs when such costs are the basis of a claim or of reimbursement to Contractor hereunder. Contractor shall keep and preserve all such books, records, accounts and other documents for a period of at least three (3) years from and after completion of the Contract term. A complete and current backup of such data shall be held in an alternative location.

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Further to the provisions of Article GC.49 hereunder titled 'LANGUAGE', and also to the foregoing provisions of this Article, Contractor shall submit his accounts and statements to MARAFIQ in English and shall maintain all his accounts, records and documents in English. They shall be accompanied by a certificate from a chartered accountant licensed to work in the Kingdom of Saudi Arabia.

GC.38 CHANGES AND EXTRA WORKS

The term "Change" or "Changes" as used in this Contract means substitutions, modifications or deletions in the Work within the Scope of the Contract. The term "Extra Works" as used in this Contract means addition to the Work within the Scope of the Contract.

MARAFIQ may, at any time, without invalidating this Contract and without notice to Contractor's guarantor or sureties, if any, make changes and may require Contractor to perform Extra Works. All the provisions of this Contract shall apply to Changes and Extra Work.

All Changes and Extra Work shall be administered in accordance with the procedure hereinafter set forth, consisting of the issuance of instructions by MARAFIQ, the submittal of an estimate by Contractor and the issuance of a Change Order by MARAFIQ. MARAFIQ, however, reserves the right to perform any Change or Extra Work with its own forces or to hire other contractors to perform such Work.

A. Instruction Directing a Change or Extra Work

When, in the opinion of MARAFIQ, a Change or Extra Work is required, MARAFIQ will issue written instructions regarding performance of the Change or Extra Work and requesting Contractor to submit in writing its estimates of the total cost based on the existing unit rate if provided in the Contract and time required for such Change or Extra Work and its proposed method of adjusting the Contract schedule and the Contract price; provided, that in the event of an emergency which, as determined by MARAFIQ, threatens to disrupt the orderly performance of the Work or endangers persons or property, MARAFIQ may issue oral instructions to Contractor to perform a Change or Extra Work and as soon as practicable thereafter, confirm of such oral instructions in writing. Such instructions, whether written or oral, may be accompanied by any specifications and data which are necessary to show the extent and details of such Change or Extra Work.

If, however, Contractor receives a written or oral instruction from MARAFIQ which in its opinion constitutes an instruction to undertake Changed or Extra Work but which MARAFIQ has not so identified, Contractor shall immediately inform MARAFIQ in writing prior to commencing performance of work covered by such instruction. MARAFIQ will review Contractor's written notice and will advise Contractor in writing if a Change or Extra Work has or has not been ordered. If not, MARAFIQ will give its written instructions directing that

(a) Contractor shall proceed with submitting an estimate in accordance with the previous paragraph; or

(b) said instructions do not constitute a Change or Extra Works and the Contractor shall comply with without any entitlement to additional reimbursement or an extension of time; or



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(c) said instructions are cancelled.

If in the case of (b) above Contractor does not agree that MARAFIQ's instructions do not give any entitlement to additional reimbursement or an extension of time then within ten (10) days of receipt of such instructions the Contractor shall give written notice of such disagreement together with a detailed explanation of its reasons for disagreeing with MARAFIQ's instructions including specific reference to the provisions of the Contract upon which its reasons are based.

Failure of the Contractor to give such notice and/or such explanation shall be deemed to be a waiver by the Contractor of any entitlement to additional reimbursement or an extension of time in relation to the matter. Unless such instructions are cancelled by MARAFIQ in writing within ten (10) days of receipt of such notice Contractor shall proceed to implement such instructions and the disagreement shall be resolved in accordance with the provisions contained in the General Condition hereof entitled "Contract Interpretation and Settlement of Disputes".

Except as provided in the event of an emergency, Contractor shall not commence Work on any Change or Extra Work prior to receiving such written instructions to do so from MARAFIQ. However, if Contractor proceeds with any Change or Extra Work without obtaining MARAFIQ's prior written approval, Contractor shall not be eligible for reimbursement for whatever cost incurred.

B. Contractor's Estimate

In the case of any Change or Extra Work, Contractor shall commence and perform such Work in strict accordance with the instructions, written or oral, received pursuant to the foregoing. Unless otherwise directed in such instructions, Contractor shall also, within TEN (10) days of the receipt thereof, submit in writing to MARAFIQ a detailed total estimate which shall set forth the increase or decrease, if any, in the in costs and time required for performance resulting from the Change or Extra Work. The estimates shall state the basis of compensation proposed for the Change or Extra Work involved; or if a Change causes a decrease in the cost of performing the Work, the amount of such decrease shall be stated. Sufficient detail shall be provided to permit thorough analysis of the estimates.

If applicable, the basis of compensation for a Change or Extra Work shall be either the unit or lump sum prices or man-hour rates (if any) if set forth in this Contract. If the rates or prices are not available in the Contract, then Contractor shall propose, for MARAFIQ approval, the new unit or lump sum prices or manhour rates not stated in the Contract for such Change or Extra Work. If the proposal is not acceptable to MARAFIQ, or if proposed compensation or the new rate for such Change or Extra Work, or any part thereof, or an adjustment in the time required for performance of the Work cannot be agreed upon, Contractor shall proceed with such Change or Extra Work in accordance with MARAFIQ instructions, shall record its costs for performing such Works and shall segregate such records from its other costs for performing the Work. Disagreements regarding such compensation or adjustment shall be resolved in accordance with the provisions contained in the General Condition hereof entitled "Contract Interpretation and Settlement of Disputes". In the event that Contractor shall be required to commence such Change or Extra Work before its estimate has been prepared and approved, Contractor shall record its costs for performing such Work.

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C. Issuance of a Change Order

When the basis of compensation and the required adjustments, if any, to the Contract Price and Contract schedule have been determined by MARAFIQ pursuant to the foregoing provisions, MARAFIQ shall issue a Change Order setting forth the total Contract adjustments to be made. Such Change Order, when signed by MARAFIQ and Contractor, shall constitute an amendment to this Contract.

In addition to terms and conditions specified above, MARAFIQ shall have the right to issue Change Order (s) which either increases the total price of the contract up to 10% (ten percent) of original contract price, or reduces the total price of the contract by not more than 20% (twenty percent) of the original contract price. The value of additional works shall not exceed the funds allocated for the project.

Notwithstanding the provisions of this general condition, if the aggregate price of the changes and extra work hereunder either increases or decreases in accordance with the above paragraph, MARAFIQ, in its sole discretion, may review the Contract Price with Contractor for purpose of negotiating revised total Contract Price for all the work performed under this contract.

D) Value Engineering

The Contractor may, at any time, submit to MARAFIQ a written proposal which (in the Contractor's opinion) will, if adopted, (i) accelerate completion, (ii) reduce the cost to MARAFIQ of executing, maintaining or operating the Works, (iii) improve the efficiency or value to MARAFQIQ of the completed Works, or (iv) otherwise be of benefit to MARAFIQ.

The proposal shall be prepared at the cost of the Contractor and shall include the items listed in below:

- A description of the proposed design and/or work to be performed and a programme for its (a) execution,
- (b) The Contractor's proposal for any necessary modifications to the Schedule and to the Time for Completion, and
- The Contractor's proposal for adjustment to the Contract Price. (c)

MARAFIQ shall, as soon as practicable after receiving such Value Engineering proposal, respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response.

If MARAFIQ approves the Value Engineering proposal the Contract Price shall be adjusted as follows:

- (1) the Value Engineering proposal shall be valued in accordance with (B) above as if was a Change instructed by MARAFIQ and the Contract Price reduced accordingly; and
- (11) there shall be a Fee added to the Contract Price calculated as 50% of the difference between
 - the reduction to the Contract Price valued as a Change in accordance with (B) above; and
 - (ii) the reduction (if any) in the value to MARAFIQ of the changed works taking into a any reductions in quality, anticipated life or operational efficiencies.

However, if amount (i) is less than amount (ii), there shall be no Fee.

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GC.39 WATER AND ELECTRICITY CONSERVATION

Contractor shall develop, discuss and implement water and electricity conservation programs in the performance of its obligations under the Contract. This may include planning and implementation of water and power use analysis and recommendation for eliminating power and water losses.

GC.40 SUSPENSION

- 40.1 MARAFIQ may, for any reason whatsoever and at its sole option suspend the Work at any time on any of its facilities or any portion of Work as it may deem necessary. Except to the extent provided under clause 40.3 below, this arrangement shall not form the subject of a claim for increased costs or damages by Contractor to MARAFIQ. During the suspension period, Contractor shall maintain and employ all Contractor's Equipment and labor in such a manner as to minimize cost associated with suspension and shall continue to execute and perform the unsuspended part of the Work. On receipt of notice to resume the suspended Work, Contractor shall immediately resume performance of the suspended Work.
- 40.2 Should this suspension impact upon the Initial Acceptance Date of the Work, MARAFIQ shall extend this date by the lesser of the amount of such impact or the duration of the suspension. There shall be no entitlement to any extension of the Time for Completion if the said suspension arose out of the Contractor's improper performance of his obligations under the Contract.
- 40.3 Buyer shall pay all reasonable expenses incurred by Seller in connection with a suspension, limited to, demobilization/remobilization, and costs of storage during suspension.

GC.41 INITIAL ACCEPTANCE

Immediately upon completion of the Work, the Contractor shall clear the site and remove all its equipment, materials, rubbish and debris and shall prepare the site to render it suitable for utilization. The Contractor shall then forward a written notification to MARAFIQ who shall fix a date for inspection of the Work in preparation for the Initial Acceptance. MARAFIQ shall fix the date for inspection in writing and within a period not exceeding Fifteen (15) days from the date of the Contractor's notification in this respect.

At the inspection for Initial Acceptance of the Work, MARAFIQ or its representative, shall inspect the Work in the presence of the Contractor or its representative and shall prepare the required minutes of Initial Acceptance. The minutes shall be made out in sufficient copies and as is necessary. When the inspection for Initial Acceptance is conducted in the absence of the Contractor, in spite of his notification by a registered letter, his absence shall be mentioned in the minutes. If it becomes evident from the inspection that the Work has been completed in accordance with the requirements of the Contract, then the date of the Contractor's notification to MARAFIQ advising him of his readiness for the Initial Acceptance shall be considered as the date of completion of Work and the warranty period begins. However, if the inspection reveals that the Work has not been executed in accordance with the requirements of the Contract, the

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facts shall be recorded in the minutes and the Initial Acceptance shall be postponed pending completion. of performance or rectification of defects in the Work, as required.

If the inspection of Initial Acceptance reveals that some items or portions of the Work have not been performed by the Contractor, but, according to the opinion of MARAFIQ's representative the said unperformed portions of Work do not preclude the utilization of the Work for the intended purpose, MARAFIQ may, in that case, consider the Work as being acceptable and request the Contractor to complete the performance of the outstanding portions in question, during a reasonable period of time and, in the event of failure of the Contractor to do so, MARAFIQ shall have the right to deduct the value of the said outstanding portions of the Work and assign to others the task of performance of the missing portion of Work, All additional Cost involved shall be at the expense of the Contractor.

In addition to the above requirements, Initial Acceptance of the Work shall also cover Contractor's submission and acceptance by MARAFIQ of Spare Parts Information Package as set forth in Clause GC.48 below.

GC.42 FINAL ACCEPTANCE

Prior to the completion of the warranty period, the Contractor shall serve a written notice to MARAFIQ to establish a date for the inspection of Work for Final Acceptance. If the said inspection proves that the Work is in conformity with the terms and specifications of the Contract, the Work shall be finally accepted from the Contractor and MARAFIQ, or its representative, shall prepare the required minutes with the required number of copies and shall, together with the Contractor or his representative, jointly sign the said minutes of Final Acceptance, of which one copy shall be handed to the Contractor.

If the Inspection, however, reveal the presence of discrepancies, defects or faults in some Work, even though such were not mentioned in the minutes of the Initial Acceptance, the Final Acceptance shall be postponed and the warranty period shall be extended until the discrepancies have been rectified and the defects and faults have been remedied and corrected by the Contractor during a reasonable period of time to be determined by MARAFIQ's representative. If the Contractor fails to carry out the said remedial Work during the specified period, MARAFIQ shall have the right, as it sees fit, to carry out the necessary remedial Works at the expense of the Contractor, or to deduct from the Performance Guarantee the value of the remedial Work as determined / established solely by MARAFIQ.

GC.43 WARRANTY

All materials and parts incorporated into the Project shall be new and shall conform to the specifications drawings, samples and other descriptions set forth in this Contract or provided by Contractor and approved by MARAFIQ, and where not specified, such materials and parts shall be of the most suitable grade of their respective kinds for their intended use and all workmanship shall be in strict accordance with this Contract and with sound technical practices. Subject to the provisions hereof, Contractor warrants the Works done by him or by any of its vendors or subcontracts of any tier against defects in the design, engineering, Materials, Plant and workmanship furnished or performed under this Contract for the

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period of twelve (12) Gregorian months from and after date of Initial Acceptance of the whole of the Works.

In case of or defects being discovered in any part of the Work performed by the Contractor during the warranty period, then the Contractor shall rectify the defect upon written notice by MARAFIQ within the period mentioned therein at a time acceptable to MARAFIQ. However, in case of failure of any part of the Work due to normal tear and wear, the warranty will not be applicable.

Contractor shall perform such tests as MARAFIQ may require verifying that such rework complies with the requirements of this Contract. Contractor warrants any rework or repair, modification, reconstruction or rectification of defects of any item or part of the Works against defects in design, engineering, materials, equipment and workmanship for the period of time of twelve (12) months from and after the date of completion and acceptance of such rework. provided that the total Warranty Period for that rework shall not exceed 18 months from the date of Initial Acceptance.

This Article provides the exclusive remedies for all claims based on failure of or defect in Products or Services, regardless of when the failure or defect arises, and whether a claim, however described, is based on contract, warranty, indemnity, tort/extra-contractual liability.

If the Project includes more than one (1) Project Portion, as may be indicated in Attachment "B", Special Conditions, of the Contract, the provisions of this Paragraph GC.43 shall be applied separately for each Project Portion.

GC.44 TERMINATION FOR DEFAULT

If any or all of the Work to be performed under this Contract is abandoned by Contractor, of the Contract or any part thereof is assigned in violation of the provisions hereof, or if any Work is sublet by Contractor without the required approval of MARAFIQ, or if Contractor becomes insolvent or unable to meet its payroll or other due obligations, or is adjudicated a bankrupt, or has an involuntary petition on bankruptcy filed against it, or makes an assignment for the benefit of creditors, files a petition for an arrangement, composition or compromise with its creditors under any applicable laws, or has a trustee or other officer appointed to take charge of its assets, or if MARAFIQ determines that the Contract schedule is not being maintained or that Contractor is violating any of the conditions or provisions of this Contract, or if MARAFIQ determines that Contractor is refusing or failing to perform properly any portion of the Work in bad faith or not in accordance with the terms of this Contract, and if, within fifteen (15) days after receipt of a written notice of default from MARAFIQ, Contractor fails to remedy such default or to provide satisfactory evidence that such default will be corrected, MARAFIQ may, without prejudice to its rights available under this Contract and without notice to the Contractor's guarantors or sureties, withhold amounts otherwise due under the Contract and/or terminate by notice Contractor's right to proceed with all or any portion of the Work.

Upon such termination or withholding, MARAFIQ shall have the right to complete any Work through a competitive bidding if reasonably available, otherwise through whatever method MARAFIQ may deem expedient, including employing another contractor under such form of Contract as MARAFIQ may choose and MARAFIQ shall have the right to take possession of the Contractor's Equipment, Materials, Plant and

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things at the Work-site and use them to perform any part of the Works that has been terminated. In case the expense of completing such Work, together with a reasonable charge for administering any Contract for such completion, exceeds the sum which would have otherwise been payable under this Contract, Contractor and its guarantors and sureties, if any, shall be liable for and shall upon notice from MARAFIQ promptly pay to MARAFIQ the amount of such excess, or such amount may be deducted by MARAFIQ out of such monies as may be due or may at any time thereafter become due to Contractor. MARAFIQ shall not be required to obtain proposals for completing such Work, but may make such expenditures as in MARAFIQ's sole judgment will best accomplish such reasonable completion. MARAFIQ shall not be liable for any damages or loss of anticipated profits on account of such termination.

Upon receipt of any such written notice of termination of right to proceed, Contractor shall continue to prosecute and perform any un-terminated part of the Work and shall, at its expense, for that part of the Work affected by any such termination:

- a) Immediately discontinue work on the date and to the extent specified in the notice;
- b) Assist MARAFIQ in making an inventory of all plant, materials and supplies at the work site, on route to the work site, or on order from vendors and subcontractors for delivery to the work site;
- Remove from the work site all plant, materials and supplies listed in said inventory other than the a) plant, materials and supplies which are designated in writing by MARAFIQ to be used by MARAFIQ in completing such work;
- b) Deliver to MARAFIQ, in the manner and to the extent determined by MARAFIQ, any data, procedures, plans, specifications, reports, estimates, summaries, completed work, work in progress, and such other information and materials as may have been acquired or prepared by Contractor in connection, with this Contract; and
- c) Make available to MARAFIQ the names and category of employment of all persons employed on the work site, other than Contractor's permanent staff, to enable MARAFIQ to employ such personnel as MARAFIQ may require to complete the Work.

For the part of the Work with respect to which Contractor's right to proceed has been terminated, all applicable provisions of this Contract shall continue in full force and effect as to all Work performed prior to the effective date of termination. For the remainder of the Work, this Contract shall remain in full force and effect.

The rights and remedies of MARAFIQ provided by this General Condition are in addition to any and all other rights and remedies provided by law or under this Contract, and nothing contained herein shall prejudice the rights of MARAFIQ to take whatever action it may deem necessary or appropriate to obtain the satisfactory performance of this Contract.

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GC.45 TERMINATION FOR CONVENIENCE OF MARAFIQ

MARAFIQ may, at any time and from time to time, for any reason whatsoever, and without notice to Contractor's guarantors or sureties, if any, terminate this Contract in whole or in part by giving written notice to Contractor specifying the part or parts of the Work to be terminated and the effective date of the termination. Upon any such termination, Contractor hereby waives any claims for damages, including loss of anticipated profits, on account of such termination, but as the sole right and remedy of Contractor, MARAFIQ shall pay Contractor an amount due and not previously paid to Contractor for Work completed in accordance with this Contract prior to such notice, and for Work thereafter completed as specified in such notice.

Upon receipt of any such notice of termination, Contractor shall, unless the notice requires otherwise:

- a) Immediately discontinue Work on the date and to the extent specified in the notice;
- b) Assist MARAFIQ, as specifically requested in writing, in the maintenance, preservation, protection and disposition of property acquired by MARAFIQ under this Contract;
- c) Deliver to MARAFIQ, in the manner and to the extent determined by MARAFIQ, any data, procedures, plans, specifications, reports, estimates, summaries, completed Work, Work in progress, and such other information and materials as may have been acquired or prepared by Contractor in connection, with this Contract; and continue to prosecute and perform any unterminated part of the Work; and
- d) For the part of the Work terminated, all applicable provisions of this Contract shall continue in full force and effect as to all Work performed prior to the effective date of termination. For the remainder of the Work, this Contract shall remain in full force and effect.

In the event of Termination for Convenience of MARAFIQ, the MARAFIQ shall pay to the Contractor the following amounts:

- 1) All amounts due and not previously paid to Contractor for Work completed in accordance with this Contract prior to such notice and for Work thereafter completed as specified in such notice.
- 2) To the extent not deemed by MARAFIQ to be recovered under (1) above, the costs reasonably and actually incurred by the Contractor in the removal of surplus materials and equipment from the work site and in the repatriation of the Contractor's and its subcontractors' personnel.
- 3) Any amounts to be paid by the Contractor to its subcontractors or suppliers in accordance with the terms of the applicable subcontract or purchase order in connection with the termination of any subcontracts or purchase orders including any reasonably incurred and unavoidable cancellation charges.

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GC.46 WORK SITE HOUSEKEEPING

With respect to Work performed at the Work-site, Contractor shall, at all times, keep the Work-site areas and facilities used by Contractor in a neat, clean and safe condition and shall dispose of all rubbish and other unwanted materials in specific areas to be designated by MARAFIQ. Contractor shall also ensure that all labor and personnel employed by Contractor in the performance of the Work are removed from the Work-site upon completion or termination of the Work. Upon completion of all Work at the Work-site and before final payment is made, Contractor shall, at its expense, satisfactorily dispose of all Contractor's Equipment and shall remove all rubbish and unused materials belonging to it or used in the performance of the Work, including the return to MARAFIQ's warehouse of any salvageable materials and supplies furnished by MARAFIQ for use in the performance of the Work but not used, and Contractor shall leave the Work-site areas and facilities used by Contractor in a neat, clean, and safe condition. In the event of Contractor's failure to comply with the foregoing, the same may be accomplished by MARAFIQ at Contractor's expense.

GC.47 RETURN OF MARAFIQ PROPERTY

Upon completion of the Work by Contractor or termination by MARAFIQ whichever is applicable, Contractor shall notify MARAFIQ in writing that Contractor is prepared to surrender or return to MARAFIQ all MARAFIQ's property in Contractor's possession in accordance with Article GC.23 hereof entitled "MARAFIQ Property". Except as otherwise provided herein, within ten (10) days from the date of receipt of such notice, MARAFIQ will commence a final inspection of such property and, upon completion thereof, either will give Contractor a Certificate of Contract Completion or will advise Contractor in writing of any repair, replacement, renovation or other action which must be furnished or performed.

GC.48 DOCUMENTS, DATA AND INTELLECTUAL PROPERTY

All materials and documents prepared or developed by Contractor, its employees or representatives in connection with the performance of the Work, including all manuals, data, procedures, plans, specifications, reports, calculations, summaries, maps, models and samples shall become the property of MARAFIQ when prepared, and Contractor shall not use such materials and documents for any purpose other than in the performance of the Work without MARAFIQ's prior written approval. Such materials and documents, together with any materials and documents furnished to Contractor by MARAFIQ shall be delivered to MARAFIQ upon completion of the Work and before final payment is made to Contractor.

SPARE PARTS INFORMATION PACKAGE

Contractor shall provide two (2) sets of original SPARE PARTS INFORMATION PACKAGE for each Parent Equipment supplied for the project. The package shall include complete component manufacturer spare parts and operating materials data. Supporting documentation specified berein shall consist of original documents.

The SPARE PARTS INFORMATION shall be identified by a cover sheet containing

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- Unpriced copy of Contract or Purchase Order
- Parent Equipment description
- Original component manufacturer name and address, including contact person, telephone, number, fax number, and e-mail address.

The Spare Parts Information shall contain the following three (3) categories to form the Parts List per equipment:

a. CAPITAL SPARE PARTS

Capital Spare Parts are those major replacement parts or complete units essential to continuous operation when long delivery or manufacturing economy is a significant factor.

b. OPERATING SPARE PARTS

Operating Spare Parts are spare parts or components that are required for continuous operation for two (2) years of the plant, equipment or system, after the commissioning of the Project.

c. OPERATING MATERIALS

Operating Materials are consumable materials that are required for the continuous operation of the Project and are consumed in the normal course of operations and, therefore, require periodic replenishment. Contractor shall quote all required quantities of chemicals, filtration materials, lubricants, desiccants, industrial gases, emulsifiers, batteries, transformer oil and any other catalysts, operating fluids, consumables.

Descriptions shall conform to MARAFIQ structured format containing noun, modifier, and multiple characteristics, and shall contain the following:

- True manufacturer name and address, including contact name, telephone number and fax number.
- True manufacturer's unique reference number(s), such as part number, catalog number, drawing/item.
- Equipment application, such as type of service.
- Unit price and applicable currency. Price information shall be but to y price valid at the time the data package is submitted.
- · Installed quantity of each part per equipment.
- Issue unit such as each, box, kit, kilogram.
- Weight in kilograms.
- Purchasing lead time in months.
- · Shelf life in months (where applicable)
- Contents of 'Kit' and 'Set', including description, quantity, and part number for each component
- Estimated annual usage quantity per parent equipment (operating materials only).
- Recommended replacement cycle in months (operating materials only).
- Pack size (where applicable).

Each single part, or group of materials of the same kind, shall be properly identified according to requirements.

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Supporting Documentation

The spare parts and operating materials data package must include sufficient supporting documentation to verify the accuracy of the data for all equipment, spare parts and operating materials. Supporting documentation shall include:

- Certified data sheets, engineering drawings (such as single line diagrams, equipment outline drawings), piping and instrumentation drawings, equipment nameplate data, manufacturer's catalog information.
- Maintenance manuals containing parts information.
- List and description of special tools and material required for maintenance, repair, and operation
 of the equipment.
- Material Safety Data Sheets for hazardous material.
- Manufacturer's guarantee that manufacturing and supplying of spare parts will continue within the next ten(10) years.

Contractor shall take all steps which may be necessary or appropriate in order that its employees and representatives adhere to the provisions of this General Condition. Appropriate clauses to carry out the purpose and intent hereof shall be included in all similar Contracts entered into by Contractor pursuant to the performance of this Contract.

Any design drawings (not shop drawings of GE parts and GE labelled system) and documents including Intellectual property attached therein that has been developed by the Contractor in performing the Work or other related activities during the currency of the Contract will belong to MARAFIQ.

Seller's Intellectual Property

- (a) Seller shall defend and indemnify Buyer against any claim by a non-affiliated third party (a "IP Claim") alleging that Products or Services furnished under this Contract infringe a patent in effect in the U.S., an EU member state or the country of the Site (provided there is a corresponding patent issued by the U.S. or an EU member state), or any copyright or trademark registered in the country of the Site, provided that Buyer (a) promptly notifies Seller in writing of the Claim, (b) makes no admission of liability and does not take any position adverse to Seller, (c) gives Seller sole authority to control defense and settlement of the Claim, and (d) provides Seller with full disclosure and reasonable assistance as required to defend the Claim.
- (b) Section (a) herein shall not apply and Seller shall have no obligation or liability with respect to any Claim based upon (a) Products or Services that have been modified, or revised when such revision or modification is a basis of the infringement, (b) the combination of any Products or Services with other products or services when such combination is a basis of the infringement, (c) failure of Buyer to implement any update provided by Seller that would have prevented the Claim, (d) unauthorized use of Products or Services, or (e) Products or Services made or performed to Buyer's specifications.
- (c) Should any Product or Service, or any portion thereof, become the subject of a Claim, Seller shall (a) procure for Buyer the right to continue using the Product or Service, or applicable portion thereof, or (b) modify or replace it in whole or in part to make it non-infringing.

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GC.49 LANGUAGE

The Contract Agreement has been translated into Arabic. All other details & attachments and forgoing provisions of this Contract are not formally translated into Arabic at the date of signature, except, otherwise when expressly required, it is the intention of the parties that it be translated to Arabic as needed. Until such arrangements are made and produced in writing, the English text of such attachments shall constitute the sole statement of the Agreement between the Parties.

All notices and communications under this Contract shall be in the Arabic Language or English Language or both as the subject may require. In case of any discrepancy between English and Arabic text, the English text shall prevail.

GC.50 STANDARDS AND CODES

When they exist, Saudi Arabian or GCC standards and codes shall be exclusively used and specified by Contractor in the performance of the Work, When such standards and codes do not exist then Contractor may use and specify other internationally recognized, standards and codes with the prior written consent of MARAFIQ. Wherever references are made in the Contract to standards or codes in accordance with which the Work is to be performed or tested, the edition or revision of the standards or codes current on the date of this Contract shall apply, unless otherwise expressly set forth. Contractor shall notify MARAFIQ of any revisions in such standards or codes during the performance of the Work, and Contractor shall be compensated in accordance with Article GC.38 hereof entitled "Changes and Extra Work" for any Changes or Extra Work required to use such revisions in the performance of the Work. In case of conflict between any referenced standards or codes and the Technical Specification set forth in Attachment "D" of this Contract, Contractor shall notify MARAFIQ to determine which standards and codes shall govern.

GC.51 INSURANCE

MARAFIQ

- 51.1 Unless specifically stated hereunder that insurance is to be provided by MARAFIQ the Contractor shall, at its own expense, carry and maintain in force at all times from effective date of the contract through the issuance of the "Final Acceptance Certificate" of the Work/Project; the following insurance policies. For the purposes only of this Clause 51, "Contract Price" shall be deemed to be the amount of compensation to be paid to the Contractor as stated in Attachment C:
 - A. Construction / Erection All-Risks Insurance: During the term of the contract, MARAFIQ shall procure and maintain All Risk insurance and/or any other equivalent coverage covering the full replacement value of Covered Unit(s), BOP Equipment, and Facility, including business interruption coverage, all of which includes a waiver of subrogation in favor of Contractor "GE" and its Affiliates;

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GE will cover up to \$250,000 per occurrence for an aggregate amount of \$1MM, as an insurance deductible to be paid by Marafiq under Marafiq's Propoerty or All Risk insurance

Policy

- B. Professional Indemnity Insurance: being coverage in respect of any professional advices/ design elements of the Work by the Contractor and its personnel and subcontractors. Such insurance shall be in an amount not exceeding SR 75 million for any one occurrence or series of occurrence and in the aggregate for the contract duration. The discovery period shall be for one year from the completion of the warranty (i.e. 1+1)
- C. Comprehensive General Liability Insurance

Coverage with policy limits of SR 5,000,000 for personal injury, death or property damage resulting from each occurrence and covering all of the Contractor's operations under this contract.

The policy should be in force until the date of Final Acceptance.

D. Marine/Air Cargo Insurance

a) Marine/Air Cargo Insurance covering all Materials and Plant for incorporation in the Works/Project against all risks of loss or damage normally insurable including war, strike, riots and civil commotion from the time that such insured property leaves the premises of the Contractor, Subcontractor or supplier outside of Saudi until arrival and unloading at site or offsite storage location.

The insured value thereof shall be one hundred and ten percent (110%) of the CIF value of such goods.

b) In the event of repair – and – return contracts, Contractor shall similarly, under equivalent terms as set out in sub-clause (a) insure the Marafiq equipment concerned from the time when risks in respect of such equipment is handed-over to Supplier while such property is located at Contractor's repair facility for repair.

E. Contractors Plant & Equipment's

The Contractor has the option to arrange insurance against "All risk of physical loss or damage to all Construction Plant and Equipment, tools and/or temporary works" brought to the site by the Contractor and its sub-contractors for their use in connection with the Contract Works. If the Contractor and its sub-contractor elect not to provide insurance for their own Construction Plant and Equipment, tools and/or temporary works brought to the site, the Contractor and the sub-Contractor shall hereby waive any right of claim for any loss or damage to their aforementioned property for whatever reason including any negligible action or omission by MARAFIQ or MARAFIQ employees.

F. Automobile Liability Insurance covering owned, non-owned and hired motor vehicle with limits of at least Ten million Saudi Riyals SR. 10,000,000.00 Combined Single Limit for Third



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Party personal injury (including blood money and awarded compensation for the injuries and the medical expenses) and Property Damage resulting per occurrence and in the aggregate during the policy period.

- G. Workmen's Compensation (or) Social insurance (GOSI) plus difference in cover (excess of GOSI) applicable to industrial illness or injury to cover all Contractor's employees. The Certificate of Insurance shall clearly indicate that the policy provides all employees with all benefits required by the law of the employee's country of origin and, if and to the extent the laws of the Kingdom of Saudi Arabia shall be applicable, all benefits required under the Laws of Kingdom of Saudi Arabia.
- H. Employer's Liability Insurance shall be provided to cover Contractor's employees with a limit of not less than 1.5 million Saudi Riyals (SR 1,500,000.00) per occurrence.
- Watercraft/Aviation Liability Insurance: "Watercraft/Aviation Liability" insurance in an amount not less than SR 3,500,000.00 each occurrence covering loss of or damage to persons or property caused by Watercraft, in Contractor's possession, custody or control, if any and not owned by MARAFIQ, used in connection with the performance of the work.
- All Risks Hull Insurance: "All Risks Hull" insurance in an amount equal to the replacement value of the hull, covering watercraft or aircraft, if any, in Contractor's possession, custody or control and not owned by MARAFIQ.

In respect to items "Watercraft/Aviation Liability" and "All Risk Hull", Contractor will not be required to carry such insurance if Contractor submits to MARAFIQ a certificate signed by the Contractor stating that Contractor does not intend to use or have it its custody, possession or control any watercraft or aircraft of any kind in connection with the performance of the work; provided, however, that in the event Contractor subsequently decides to use any such watercraft, or aircraft,, Contractor shall submit MARAFIQ, at least thirty (30) days prior to the date of intended use, a certificate of insurance as evidence that the insurance coverage specified in said items are in full force and effect.

- 51. 2 Minimum Coverage: MARAFIQ and Contractor agree that the insurance coverages listed under Articles 51.1.A to 51.1.J above are minimum coverages required to be purchased by Contractor under this contract. Should any loss occur for which Contractor is responsible, Contractor shall be liable for the full amount of the loss, including the amount in excess of Contractor's insurance limits and including the amount of any deductible specified in Contractor's insurance policy.
- 51.3 Certificate of Insurance: Contractor shall submit MARAFIQ, at least thirty (30) days prior to the date of intended use, a certificate of insurance as evidence that the insurance coverage specified in said items are in full force and effect.

Contractor shall have to furnish to MARAFIQ, an Original "Insurance Certificate" in the attached format (blank format is attached under GC 58) specifying the types and amounts of coverage in effect and the expiration dates of each policy, and a statement that no insurance will be cancelled or materially changed without ninety (90) days prior written notice to MARAFIQ. The Insurance

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Certificate shall be signed by the authorized person of the Insurance Company. All Insurance policies shall be taken with one of the SAMA approved Insurance Company within the Kingdom. Contractor shall permit MARAFIQ to examine the original insurance policies or at MARAFIQ's option, Contractor shall furnish MARAFIQ with copies of Insurance policies issued by the Insurance Companies as being true and complete. MARAFIQ's approval of or no objection to Contractor's insurance certificate or policies shall not relieve Contractor of any obligation or liability under this contract. No payments will be processed by MARAFIQ unless and until acceptable Insurance certificates are received

51.3.1 Before site mobilization and commencement of the work, Contractor shall furnish MARAFIQ- finance department the above said original "Certificate of Insurance" and the copies of the policies as an evidence that the Contractor - furnished insurance Coverage are in full and in force. No payment will be processed by MARAFIQ unless acceptable Insurance certificates are received.

All insurances maintained by Contractor, by the terms thereof, shall be primary to and not contributing with any insurance carried by MARAFIQ. In all insurance coverage purchased by Contractor, Contractor shall have the insurance carriers waive all rights of subrogation against MARAFIQ, Royal Commission for Jubail & Yanbu; the affiliated companies of each and any of their officers, directors, employees, agents and appointed representatives.

Comprehensive General Insurance, Automobile liability, Employers liability and liability policies shall designate MARAFIQ, Royal Commission as an additional insured as regards MARAFIQ's, Royal Commission liabilities for work performed by Contractor pursuant to this contract. Such policies shall contain a cross liability clause so that MARAFIQ, Royal Commission and Contractor are regarded as third parties to each other.

- 51.3.2 Subcontract: If Contractor subcontracts any part of the work, Contractor shall require its subcontractors to maintain insurances specified in the contracts and assume liabilities which are consistent with those required of Contractor under this agreement.
- 51.3.3 Exclusions: The insurance policies taken out by the Contractor shall not contain any exclusions or sub-limits of indemnity deemed by MARAFIQ to be unreasonable. In deciding what is unreasonable MARAFIQ shall take into account current insurance market practice and the estimated cost of the loss or damage being insured. The cost of all deductibles, exclusions and amounts not recovered from the insurances provided by the Contractor shall be borne by the Contractor.
- S1.3.3 Renewal: Contractor shall furnish MARAFIQ with a renewal certificate of insurance not more than one (1) week before that renewal date of each policy.
- 51.4 Assignments of Insurance and Application of Proceeds: The Contractor shall assign MARAFIQ all of its rights, title and interest in, under and to, and all proceeds payments and rights PROCUREMENT زيان والعة

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arising from the Insurances referred to under "Erection All Risks", "Professional Indemnity" "Comprehensive General Liability" and "Marine Cargo" and any claim proceeds from such insurances shall be payable to MARAFIQ. Subject otherwise to any requirements of MARAFIQ, the four insurances referred above shall be endorsed with loss payee conditions in favour of MARAFIQ

MARAFIQ Property, as indicated in this Article GC.51, shall include properties leased by MARAFIQ from the Royal Commission for Jubail and Yanbu.

GC.52 INFORMATION FURNISHED BY MARAFIQ

MARAFIQ shall furnish Contractor any information and data readily available to MARAFIQ, which may be useful to Contractor in the performance of the Work. MARAFIQ shall make reasonable attempt to ensure the reliability, accuracy or completeness of any information or data it may furnish hereunder. MARAFIQ, however, assumes no responsibility for any Work which is based upon such information or data. The failure of MARAFIQ to furnish any such information or data shall not affect the obligation of Contractor to perform the Work hereunder.

GC.53 ENTIRE AGREEMENT AND APPROVALS

This Contract embodies the entire agreement between MARAFIQ and the Contractor relating to the Work, and the parties shall not be bound by or be liable for any statement, representation, promise, inducement or understanding of any kind or nature relating to the Work which is not set forth or provided for herein. Any Work provided for herein which was performed or caused to be performed by Contractor prior to the date of this Contract shall be deemed to have been performed under this Contract. Except as provided in Article GC.38 hereof entitled "Change and Extra Work", no changes, amendments or modifications of any of the terms or conditions of this Contract shall be valid unless made in writing and signed by both Parties. In addition, all approvals, consents and determinations by MARAFIQ shall be in writing, and such action, or failure to act, by MARAFIQ shall not relieve Contractor of its responsibilities for performance of this Contract.

GC.54 WAIVER

None of the provisions of this Contract shall be considered waived by MARAFIQ unless such waiver is produced in writing and signed by MARAFIQ. No such waiver shall be construed as a modification of any of the provisions of this Contract or as a waiver of any past or future default or breach hereof, except as FOTRICINT'S INC STITUTE STATE expressly stated in such waiver.

GC.55 FORCE MAJEURE

Each Party hereto shall be entitled to an appropriate extension of large for performance of its respeobligations under this Contract other than obligations for the payment of a sum of money due under this

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Contract, if such performance is prevented or delayed by Force Majeure. Force Majeure means any condition, existing or future, which is beyond the reasonable control and without the fault or negligence of such Party and that condition was not foreseeable by such Party at the time when this Contract was entered into and which such Party by taking reasonable steps could not have prevented and which is not substantially attributable to the other Party. Such conditions shall include, without limitation, acts of God, war, terrorism, fire, floods and interference by Civil or Military authorities and exclude labor disturbances by employees of the Contractor and/or his Sub-contractors or Vendors such as but not limited to boycott, strike and lock-out, go-slow, occupation of factories and premises; and late performance by a Subcontractor caused by a shortage of supervisors or labor, inefficiencies, or similar occurrences; and late delivery of Plant or Materials caused by congestion at a manufacturer's plant or elsewhere, shortage of raw materials, inefficiencies, or similar occurrences.. Such party shall give, within seven (7) days of the commencement of any such delay, to the other Party a written notice thereof and of the anticipated results thereof, and within seven (7) days after the termination of any such delay, shall file an additional written notice with the other Party specifying the actual duration of such delay.

In the event of any such condition, the Party whose performance was delayed or prevented shall take all necessary measures to mitigate and minimize the effect of such delay and to continue with the prompt and diligent performance of its obligations under this Contract.

Contractor shall have no obligations to MARAFIQ nor shall MARAFIQ have any obligation to Contractor with respect to any damage to or loss of property or for additional costs caused by any Force Majeure.

If a Force Majeure event/s continues more than 120 days, both Parties shall confer to discuss and agree on a satisfactory solution.

If any loss or damage happens to the Project/Works, Materials, Plant or other things from any cause of Force Majeure event/s during the period when the Contractor is responsible for their care and custody, Contractor shall, subject to MARAFIQ sole determination, either:

- Apply any and all insurance proceeds it receives in connection with the damage to or loss of the Project Works towards the repair, reconstruction or replacement of the Project Works or any part or component forming a part thereof, or;
- b) Pay or cause to be paid to MARAFIQ any and all insurance proceeds received in connection with the damage to or loss of the Project Works or any part or component thereof.

GC.56 PROJECT RISK MANAGEMENT & CONTROL PLAN

Contractor shall be responsible in developing and implementing Risk Management & Control Plan from the Contract award to the Initial Acceptance of the Project. Its purpose is to identify risks related to the Project with the aim of developing a Risk Response Plan and monitor & implement it through the issuance of a Project Risk Control Plan. It covers the risk management activities to be performed during the Project phases starting from initiation, planning, execution, monitoring & controlling until closing-out.

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GC.57 REGULATION OF THE NATIONAL COMMISSION FOR CORRUPTION FIGHTING

Contractor shall carry out the following works in accordance with the second paragraph of Article 3 of the regulation of the National Commission for Corruption Fighting:

- 57.1 A signboard shall be put up at the site if the project value exceeds Saudi Riyals Five Million (SR 5,000,000). The signboard shall contain the following information:
 - a. The name and site of the project as stipulated in the contract
 - b. The name of executing contractor for the project
 - c. The date of signing of the contract
 - d. The contract value
 - e. The date of site handing over (Notice to Proceed date)
 - f. The fixed date of project completion and preliminary handover (initial acceptance of the project)
 - g. In case of project extension, the contract extension period (commencement of the extension and end of the extension) shall also be mentioned
 - h. The name of the consultant supervising the execution of the project
 - i. The value of the consultant contract
- 57.2 The signboard shall not be less than 3 meters x 4 meters, and shall be manufactured of weather-resistant material, and shall be fixed firmly.
- 57.3 The data written on the signboard shall be clear and readable from a distance.
- 57.4 The signboard shall be fixed in a conspicuous place at the project site, and if the project extends for a long distance (such as roads, water, flash floods and drainage projects), there should be three (3) signboards, one at the beginning, another in the middle and the third at the end of the project site.
- 57.S An office shall be established at the project site (if it does not exist yet) which contains the project charts, designs, contracts and documents, in order to be within the reach of the Commission employees who are visiting the project, at any time.

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GC.58 CERTIFICATE OF INSURANCE

INSURANCE COMPANY LETTER HEAD

This is to certify that the company named herein has issued, to the insured named herein policies of insurance which provide, subject to the insuring agreements, exclusions, conditions and declarations contained therein, and during their effective period, coverage as described below:

- A. Name and Address for Whom this Certificate is Issued
 Power & Water Utility Company for Jubail and Yanbu (MARAFIQ)
 P.O. Box 11133, Jubail Industrial City 31961, KSA
- C. (______) is the insurer for all coverages listed below
- D. <u>Description of Operation and Location Covered</u>

 All Operations of the named Insured regarding ______in

 connection with Industrial City by Contract No. -----
- E. Policies in Force (as applicable)

B. Name and Address of Insured

Coverages	Policy No.	Effective Date	Expiration Date	Limit of Indemnity	
1. Erection All Risks Policy	()			Full Contract Value	
2. Professional Indemnity				3 MARATE	
3. Comprehensive General Liability Insurance	()	(St)	88.00	PROCUREMENT	
4. Marine Cargo Insurance	()	All Designation	THE THE PERSON NAMED IN COLUMN TO PERSON NAM	110% of the CIF value of the goods.	
5. Contractors Plant and Machinery Insurance	()	NI TRIO BITTI INC	1180007		
6. Motor Vehicle Liability (for all vehicles in use) No. of Vehicles	()	And South		Not Less than SR 5,000,000 each occurrence for Bodily injury and SR 5,000,000 each occurrence for property damage, for a total of SR	

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Coverages	Policy No.	Effective Date	Expiration Date	Limit of Indemnity	
Or Driver's License Ins. Certificates (for all drivers)				10,000,000.	
7. Workmen's Compensation				All employees with benefits required by Saudi Arabia Law and all benefits required by the laws of each employees country of origin to the extent that these benefits exceed the benefits required by Saudi Arabian law.	
8. Employer's Liability				Each occurrence not less than SR1,500,000	
9.Watercraft/Aviation liability (if required)					
10. All Risk Hull (if required)					

F. We Certify That:

- The Power & Water Utility Company for Jubail and Yanbu (MARAFIQ) and any designated authorized representatives thereof including parent, associated, affiliated and subsidiary companies have been named as additional Insured's under the above policies
- 2. Each policy provides a waiver of subrogation in favor of all insured parties in the following form:

Waiver of Subrogation

The Insurers hereby waive subrogation as to any right of recovery which the insured may have against any insured parties including Power & Water Utility Company for Jubail and Yanbu (MARAFIQ), the Royal Commission for Jubail and Yanbu, and their parent and affiliated, associated and subsidiary companies and the officers, directors, agents, servants and employees of any of them.

3. Each policy provides for severability of interest in favor of all insured parties in the following form:

Severability of Interests

The Term "The Insured" is used severally and not collectively and the insurance afforded by this policy applies separately to each insured against whom claim is made or suit is brought but the inclusion herein of more than one insured shall not operate to increase the limits of the increase liability.

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- The insurance company hereby agrees to provide MARAFIQ with written notice ninety (90) days prior to the effective date of any material change, cancellation or non-renewal.
- All coverage hereunder shall be primary to and not contributing with any insurance carried by MARAFIQ.
- 6. It is also declared and agreed that loss payee for any claims arising under Erection All risks policy, Professional Indemnity, Comprehensive General Liability policy and Marine Insurance will be MARAFIQ and whose receipt will be valid discharge to the named Insurance Company (applicable for Contracts with value of SR 100 million and above).

This certificate will be considered as binding on insurers and has been signed by persons authorized to commit the insurers shown hereon.

Date Issued:	
Ву:	**************************************
Signature of Insurer's Authorized representative Name:	
Title:	
Insurance Co. Seal:	
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	



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KINGDOM OF SAUDI ARABIA POWER & WATER UTILITY COMPANY FOR JUBAIL & YANBU (MARAFIQ)



ATTACHMENT "B" SPECIAL CONDITIONS

Contract PO No. 7200026909

Gas Turbine Generators Rehabilitation by Replacement of Major Parts - YANBU





SPECIAL CONDITIONS

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SPECIAL CONDITIONS

SC-1 Contract Schedule

Contractor shall submit to Marafiq for approval a detailed contract schedule showing activities and sequence of operations needed for the orderly performance and completion of every separable part of the work in order to meet the dates for the major contract events. The detailed contract schedule shall be in the format (i.e., bar chart or CPM) established for the preliminary contract schedule, unless otherwise designated by Marafiq upon the commencement of this contract. The detailed contract schedule shall be completed in all respect covering all activities relating to the work both on-site and off-site. Such schedule shall show in detail the intended sequence, timing, rates of progress and the interrelation of all element of the work. Contractor's submission shall also include a manpower forecast by discipline and craft and a detailed narrative description of Contractor's plan for performing the work.

Contractor's submission, as modified and approved by Marafiq, shall become the contract Schedule and Contractor shall thereafter prosecute the work in accordance therewith. Contractor will be permitted reasonable variation in the sequence of activities shown on the contract schedule, provided that (1) such variation does not jeopardize timely completion of the work, or portions of the work having separate completion dates, (2) no interference to the operation of others performing work for the Project is caused thereby, and (3) such variation shall be subject to prior approval of Marafiq. Contractor shall at all times notify Marafiq of any such proposed variation and of its day schedule of operations. No change, other than the variations described above, shall be made to the contract schedule except as authorized by a change order in accordance with the terms of the General condition hereof entitled "CHANGE AND EXTRA WORK".

The failure of Contractor to comply with such instructions of Marafiq be grounds for determination by Marafiq that Contractor is not prosecuting the work with such diligence as will assure performance within the times specified. Upon such determination, Marafiq may terminate Contractor's right to processed with performance of the work, or any separable part thereof, in accordance with the applicable provisions of this contract, in addition to whatever rights Marafiq may have.

SC-2 Commencement and Completion

Contractor shall commence performance of the work upon the date specified in the Letter of Intent (LOI) and complete the work for period of thirty six (36) Gregorian months.

GTG Rehabilitation

SC-3 Contractor's Obligations

The Contractor shall be responsible performing, providing and complying with the following items;

- a) The Contractor shall perform the services as identified in the Scope of Work according to Marafiq requirements and with consideration and due diligence to achieve the objectives of this contract.
- b) The Contractor shall regularly report to, and obtain direction and guidance from Marafiq on all matters relating to the present contract.
- c) The Contractor shall promptly comply with such instructions as may be issued from time to time by Marafig in connection with the performance of the services.
- d) The Contractor shall submit to Marafiq satisfactory and complete report in accordance with the contract and at such intervals as Marafiq may require.
- e) The Contractor shall keep and maintain accordance and complete accounts in respect of expenditure incurred under the present contract in such form and detail as shall be satisfactory to Marafiq for the purposes of making payment or settlement of accounts under the contract.
- f) The Contractor shall seek and obtain any visa or residence permit that he may require to carry out the services and perform his obligations under the present contract.
- g) The Contractors shall study the project and the scope of the various elements according to Marafiq requirements and consideration to achieve the requirements of Marafiq.
- The Contractor shall establish a clear conception of the appropriate method of performing the services and expected cost shall be further studied upon completion.

SC.4 Contractor's Personnel

- The Contractor shall employ and provide for the performance of the services, a sufficient number of specialized and technical personnel in his offices and work sites.
- 2) The Contractor shall appoint one of his technical personnel as project manager, provided that he has the suitable qualifications, to be available at the Contractor's office throughout the contract period and provided that his appointment shall be



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subject to Marafiq's prior written approval. The Contractor shall, upon the direction of Marafiq, replace his project manager by another qualified one approved by Marafiq.

- The Contractor shall observe that his personnel are working in a legal manner and shall provide evidence of this to Marafiq.
 - a) Except as Marafiq may otherwise agree in writing, which shall not be unreasonably withheld, no unreasonable changes shall be made in the key Personnel. If, for any reason beyond the reasonable control of the Contractors, it becomes necessary to replace any of the key Personnel, the Contractors shall provide as a replacement a person of equivalent or better qualifications.
 - b) If Marafiq finds that any of Personnel have (i) committed serious misconduct or have been charged with having committed a criminal action, or (ii) have reasonable cause to be dissatisfied with the performance of any of the personnel, then the Contractors shall, at Marafiq's written request specifying the grounds thereof, provide as a replacement a person with qualifications and experience acceptable to Marafiq.
 - c) The Contractors shall have no claim for additional costs out of or incidental to any removal and/or replacement of personnel.

SC.5 The Contractor's Liability for Work

- The Contractor shall be responsible for damage resulting from any faults in the designs and specifications prepared by him. The approval of Marafiq of such designs and specifications shall not relieve the Contractor from his responsibility.
- 2) The Contractor shall bear all consequences resulting from claims raised by others against his breach of any right, concession, design or trademark.
- The Contractor shall bear all consequences resulting from damages to others caused the fulfillment of contract obligations.

SC-6 Performance Security Bond

Within the time required by Marafiq, but not later than Seven (7) days after the date of this Contract or after the commencement date specified in the Notice to Proceed issued to Contractor hereunder, whichever is earlier, Contractor shall deliver to the Marafiq (Finance Department) an unconditional bank guarantee payable to the order of Marafiq in a form and issued by a bank acceptable to Marafiq. No payment will be processed by Marafiq unless an acceptable Performance Bond/Bank Guarantee is received. Such performance security shall be valid until the issue of the Final Acceptance certificate by Marafiq to the Contractor indicating that Contractor as completed all its obligations under the Contract.

The performance security shall be in an amount equal to five percent (5%) of the total Contract Price for the entire Contract period.

If, at any time, the total Contract Price is increased or decreased by a Change Order issued pursuant to the General Condition hereof entitled "Change Order", such Change Order may also require an adjustment in the amount of the Performance Security to reflect such increase or decrease.

Should the Contractor fail to complete the work within the period specified under SC-2 above, the Contractor shall automatically extend the validity of the Performance Bond to cover the warranty period.

SC-7 Annexures

- a) Addendum 1
- b) Addendum 2
- c) Pre bid Clarifications 1
- d) Pre bid Clarifications 2
- e) Pre bid Clarifications 3
- f) Pre bid Clarifications 4
- g) Post bid clarifications Mechanical 001
- h) Post bid clarifications Mechanical 002
- i) Post bid clarifications Mechanical 003
- i) Post bid clarifications Mechanical 004
- k) Post bid clarifications Project Management 001
- I) Post bid clarifications Electrical 001
- m) Post bid clarifications Electrical 002
- n) Post bid clarifications I&C 001
- o) Post bid clarifications I&C 002
- p) Post bid clarifications I&C 003
- q) Post bid clarifications I&C 004
- r) Post bid clarifications 1&C 005
- s) Post bid clarifications Civil 001
- t) Technical Deviations
- u) Division of Responsibility

Note:

In case of any Technical dispute, the hierarchy of agreements on the project will be as follows:

- 1) Post bid clarifications
- 2) Pre Bid clarifications
- 3) Scope of Works

---ooo---Nothing Follows---ooo---





Ref: PC-Y-15-0240 Date: 26 May 2015

ADDENDUM No. 1

RFP Collective No. EDJ-6947 GTG Rehabilitation by Replacement of Major Parts Yanbu

To All Bidders:

MARAFIQ hereby issues Addendum No.1 to the bid documents for RFP Collective No. EDJ-6947 with the following provisions:

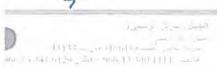
 To add in the Scope of Works (Section IV R, Replacement of Gas Flow meter & Other Field Instruments for GTG Units 1 – 9, Section 3, Brief Work Description) the Hazardous Gas Detection System for Gas Turbine Enclosures, as follows:

The Contractor shall design, supply, install, test and commission catalytic bead type LEL(Lower Explosive Limit) gas detectors for hazardous gas detection in accessory compartment, turbine compartment and load compartment for each gas turbine generator, generator collector cab as per TIL 1566-R1, dated 10 February, 2014. The LEL detectors shall be provided with explosion proof/flameproof housing certified for Class I, Division 2, Group A, B, C, D location.

Leaks of Sales gas and Hydrogen must be detected to prevent the buildup of explosive levels, particularly in enclosed spaces, and dedicated LEL detectors shall be provided for Gas Turbine enclosures and Generator Collector cab per TIL 1566-R1. Type of LEL detectors and location shall be decided based on the potential leak source and accumulation gases in enclosed spaces.

The LEL detector shall be interfaced and integrated to upgraded Mark Vie GTG Turbine Control System. All alarm and trip set points associated with LEL gas detectors shall be configured in local operator work stations for each GTG unit. The LEL detector shall be capable to operate in harsh environment and capable to operate at high temperatures up to 120 Deg C.

The Contractor shall prepare electrical hazardous area location plan drawing along with location of LEL detectors as per TIL 1566-R1, dated 10 February, 2014 for each GTG unit



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Please be guided accordingly.

Regards,

Tariq Ribhi Dahmash

Supervisor, Procurement Projects - Y Procurement & Contracts Department

Tel: 04 396 6064

Email: dahmashtr@marafiq.com.sa



Connections

3.2

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Addendum to an Existing Contract

This document is in reference to an ITB for Project: PR# 7000006947 - Gas Turbine Generators Rehabilitation by Replacement the Major Parts Scope of Work,

Make the following changes and / or additions that are outlined below. These additions shall be made valid as if they are included in the original stated contract.

Stated Contract for: <u>Implementations of GE TIL 1819-R2 for Turbine Shell to Exhaust Frame Flange</u>

<u>Slippage GTG units 1 to 8</u>

- 1. The Axial Dowel Configuration should be changed to 12 radial Dowel Configuration.
- 2. Modify the Exhaust plenum to have the provision for Exhaust casing jacking arrangement







GTG REHABILITATION DOR COMMENTS

Contract PR No: 7000006947

Contract Title: GTG Rehabilitation

Contractor: GE

Review Subject: Division of Responsibility



Task No	Tasks	Marafiq comments		
26.1	Mechanical Out line Drawing (ML:306)	GE's responsibility to retrieve the required drawings and documents from Marafiq's Documentation Control Centre.		
26.2	Electrical Out line Drawing (ML:301)			
37	Generator customer drawing and documents			
37.3	Owner's manual			
201	Marafiq Owned crane requirements	Marafiq agreed that the GTG building crane only can utilized by GE, other requirement will be full filled by the Contractor.		
208	Storage area & Inventory plan	During Technical clarification stage we requested to M/s GE area requirement. GE was not provided, however we have given the Rental rate from RC for the Storage and		
209	Laydown area	laydown area.		
1090	Hazardous waste removal (Batteries , Oil, Etc.,)	GE Shall complies the RCER standard and procedure for Hazardous waste management.		
1100	Demolition	Marafiq shall decide that Removed items Whichever can be reusable like Stator and Switch gear and scrap items. However during beginning of this project M/s GE agreed that the removed Compressor and turbine rotor can stored with replaced rotor boxes.		
1210	All permits related to site work	M/s GE also has the responsibilities considering all PTWC,S are required APR from GE not only API by Marafiq; all required documents should be prepared by GE which needed for PTWC implementation.		
2520	Generator Bus Duct	Bus Duct may need change arrangements/tapping by GE for the provision for (HV 13.8Kv) primary supply of PPT if static excitation is used.		
2680	Flue gas conditioning	GE was indicated that Marafiq Responsibilities, Please brief about the same. Hence the flue gas monitoring and validate the Nox control in the GE scope.		
2690	Interconnecting Pipe , valve and fittings	Water injection system shall complies as per SOW, This cover from DM water Transfer pump with piping and storage and distribution.		
2700	Distributed control system	These two statements are contradicting. It is already mentioned in GE Proposal file "1- Marafiq YANBU - Plant Rehab-778781-15-YGTZ_Technical (2)" at page No.40 that Mark 6E controller and ABB DCS and SOE will be interfaced through Modbus Ethernet communication's it should be corrected in Division of Responsibility.		
		But GE has not included SOE system in this Division of Responsibility. So GE should include SOE interface in between Mark 6E controller and ABB DCS and GE should review the existing SOE list and incorporate the electrical signals. Which are missing in existing mark v controls.		
6404	Install distributed control system panels	What dcs and where to install and what purpose? Please expedite		
7204 - 7206	Energize HV/MV/LV	Marafiq also have the responsibilities, hence this will disturb the Existing system.		





9301	Security	Marafiq considered that M/s GE will hire the Land from RC for their Storage and laydown area against that security in GE scope.
9308	Trash containers & disposal of all material used	Disposal should be responsible by GE under the contractor have license with RC Environmental policy.
9309	Personal safety Equipment	This in GE scope
9310	Fire Extinguishers	
9318	Change facilities for crew	Marafiq considered that M/s GE will hire the Land from RC for their Storage and laydown area against that whichever facilitation required in the scope of GE.
9319	First aid facilities Ambulance services	
9327	Receiving ,off-loading and proper storage of all new and refurbished parts	
9333	Designated work and laydown areas accessible to crane and turbine	
9329	Operational personnel to perform all normal functions of T-G equipment (shutdown, start up ,drain and fill oil system,etc.,)	Marafiq also have the responsibilities.
9338	All permits, licenses, governmental or public utility charges and inspection fees	This is GE scope, if required Marafiq will Provide the Support for the same.
		During Technical evaluation whatever is agreed by GE in file No. "GE-PBC-IC-003_R3_GE (29 OCT 2015)" and "GE-PBC-IC-005_R1_GE (13 SEP 2015)" and whatever given in GE proposal file "1- Marafiq YANBU - Plant Rehab-778781-15-YGTZ_Technica (2)",All that must be GE responsibility and it must be included in Divison of Responsibility. For example Nox control water injection skid commissioning.
		It is already mentioned in GE Proposal file "1- Marafiq YANBU - Plant Rehab-778781-15-YGTZ_Technical (2)" at page no.53 CENTRAL CONTROL ROOM. Installation of new EWS HMIs in the existing consoles Installation of New PI historian in existing Console desk. It should be included here as GE Responsibility in Divison of Responsibility





PR NO. 7000 006 947

GTG Rehabilitation by Replacement of Major Parts, Yanbu



Clarification # 1-4

Subject : Pre bid clarification # 1

NO.	BIDDER'S CLARIFICATION	MARAFIQ RESPONSE	GEII Saudi Response	MARAFIQ RESPONSE	
1	As per the bid document we have noticed that MARAFIQ is requiring the bidder (GE) to inquire Hitachi material and Hitachi services for the purpose of stator and rotor rewind for the generators. We are in GE have in house capabilities to conduct the necessary work on the generators at MARAFIQ without the need to approach Hitachi. Please clarify that providing GE material and service for the generator stator and rotor rewind is acceptable to MARAFIQ.	Bidder can propose their solution and their experience profile along with their Technical offer for our evaluation.	Noted	Noted.	
2	We would like to request MARAFIQ to give us a window of seven (7) days on the GT unit which will have the earliest outage to allow us to do the necessary survey/measurement on the generator. The requirement will require the GT unit to be down. GE will provide all necessary manpower, tools and equipment to dismantle, pull the rotor, and assemble the generator back to its original condition. Further coordination will be made with the site concerning special tools or needed equipment that can be available for fast access.	We cannot guarantee window for time being since there is not any type of formal contract. Window can be guaranteed later if the contract signed.	Please note that we have and agreement with MARAFIQ related to generator work that is still valid (MARAFIQ/GE Agreement No.7300 005 802). Please approve us via that agreement to have the 7 days window.	MARAFIQ/GE Agreement No.7300 005 802 is valid for GTG - 9 area only.	
3	Please provide a copy of the Generator Operation & Maintenance manual, operation data, and foundation layout.	Files will be sent to you via CD copy	Noted	Noted.	
4	Please provide the liquid fuel (Distillate fuel) specification	Refer Enclosed	Received	closed	







				0.70	PR NO. 7000 006 947		MARAFIQ
GTG Rehabilitation by Replacement of Major Parts. Yanbu Subject Pre bid clarification # 2							Clarification # 1-74
ITEM NO.	RFP section	Section Title	Sub- section /page	Related Scope	Specification Clause	BIDDER'S CLARIFICATION (May 4th)	MARAFIQ RESPONSE (May 15th)
1	Section IV K	Protection Relays	General	Electrical Substation	Clause 1A,Page 168	As per scope of work under description of work clause A, "The intent of the project is to replace the relays and other related items in the panel without removing panel itself" Hence GE upgrade will be on the existing panels without replacing the panels. Please confirm our understanding is correct or not	Yes. Only the relays are to be replaced, and not the panel itself.
3	Section IV K	Protection Relays	General	Electrical Substation		Please provide us the as built drawings related to the protection scope.	The drawings required for bidding purposes have already been provided to you for bidding purpose
4	Section IV K	Protection Relays	General	Electrical Substation		Please provide us the protection one line of GT generator and unit substation drawing	The drawings required for bidding purposes have already been provided to you for bidding purpose
5	Section IV K	Protection Relays	General	Electrical Substation		Please provide us the existing protection setting details.	Vendor to find these details from MARAFIQ Library after award of the Contract
6	Section IV K	Protection Relays	General	Electrical Substation		Manual, Auto synchronism, meter/transducer, upgrade on control panels are not part of the scope. Please confirm	Upgrades of Speed Tronic from Mark V to Mark Vie' is included. Please refer the SoW.
7	Section IV K	Protection Relays	General	Electrical Substation		UCS interface protocol will be on MODBUS. Please confirm	Confirmed. Bidder's understanding is correct.
8	Section IV S	MV SWGR	General	Electrical Substation		or send the BOQ, of all subject units	It has been clearly specified that 'The purpose is to replace the old 4.16KV breakers within existing switchgear with new modern circuit breakers. Since the breakers will have to be installed in the existing switchgear assembly, all interfacing of the existing breakers with the switchgear assembly will have to be retained'.
9	Section IV Q	LV MCC	General	Electrical Substation		the BOQ, of all subject units	It has been clearly specified that 'The purpose is to replace Seven (7) unit of the old 480V existing MCC panel with new modern 480V MCC panel with each breaker having the ground fault protection capability'.
10	Section IV L	LV SWGR	General	Electrical Substation		Specify exactly the replacement part from the 600V SWGR or send the BOQ, of all subject units	Refer to Section IV-L, wherein the scope has been clearly specified.
11	All	LV/MV SWGR & MCC	General	Electrical Substation			All drawings are provided to you with RFP. The 600 V dwgs are also provided which form part of 4.16 kV switchgear dwgs. However we are again re-attaching it.
12	Section IV O	EX2100e	1		Project Objective The objective of this project is to upgrade the existing Excitation System including Automatic Voltage Regulation (AVR) by replacing obsolete ones, with the latest Digital type Excitation System & Automatic Voltage Regulators (D-AVR) for Gas Turbine Generators (GTGs) No. 1, 2, 3, 5, 7 and 8 Of MARAFIQ at Yanbu.		Bidder's proposed solution is not acceptable to MARAFIQ since existing EX2000 can still communicate to Mark Vie using ARCNET to ETHERNET gateway/protocol converter. This information is already provided in "Mark* VIe Control Migration from Mark V Control". So there is no need to upgrade existing EX2000 system of GTG-9. Bidder shall note that there is ARCNET to ETHERNET gateway available with GE for provision of communication of Ex2000 to upgraded MarkVie.





Continuation	Bidder Response (May 31)	MARAFIQ RESPONSE (June 3)	Bidder Response (June 10th)	Marafiq Response
1			Closed	Closed
3			Closed	Closed
4			Closed	Closed
5			Closed Closed	Closed Closed
6			Closed	Closed
7			Closed Closed Closed	Closed Closed
8			Closed	Closed
			Closed	Closed
9			Closed Closed	Closed Closed
10			Closed Closed	Closed Closed
11			Closed	Closed
12	MarkVie Migration solution only. On Full	Closed. Noted. Bidder proposal for replacement of EX2000 is acceptable to MARAFIQ per justification.		Closed







13	Section IV O	EX2100e	4	Controls	Bidding Requirements for the program The Bidders are required to prepare and submit their bids for replacement of existing obsolete Excitation System including AVRs with the latest product of Excitation System & Automatic Voltage Regulator (AVR), for Six (6) of Gas Turbine Generators (GTGs) No. 1, 2, 3, 5, 7 and 8 of MARAFIQ at Yanbu. It is the sole discretion of MARAFIQ to release any of the unit (s) for implementation of the work under this Contract. Plant operation however, shall always be given priority over the contract work.	Existing exciter on GT9 is EX2000 AVR which currently is communicating with the existing Mark V via Arcnet (not Ethernet). Since MKV on unit 9 is changing to Mark Vie, EX2000 needs to also be upgraded to EX2100e so to be able to communicate via Ethernet.	Bidder's proposed solution is not acceptable to MARAFIQ since existing EX2000 can still communicate to Mark Vie using ARCNET to ETHERNET gateway/protocol converter. This information is already provided in "Mark* VIe Control Migration from Mark V Control". So there is no need to upgrade existing EX2000 system of GTG-9. Bidder shall note that there is ARCNET to ETHERNET gateway available with GE for provision of communication of Ex2000 to upgraded MarkVie.
14	Section IV O	EX2100e		Controls	The work to be performed under this Contract consists of furnishing labor, supervision, tools, equipment, technical and professional services, materials supplies and all articles necessary to perform work involved in replacement of existing Excitation System & Automatic Voltage Regulators (AVRs) with the most up-to-date generation of Digital type Excitation System & AVR as well as integration with the UCS/DCS and Mark-VIe systems for Gas Turbine Generators (GTGs) No. 1, 2, 3, 5, 7 and 8 at Power & Water Complex facilities of MARAFIQ Yanbu	Existing exciter on GT9 is EX2000 AVR which currently is communicating with the existing Mark V via Arcnet (not Ethernet). Since MKV on unit 9 is changing to Mark Vie, EX2000 needs to also be upgraded to EX2100e so to be able to communicate via Ethernet.	Bidder's proposed solution is not acceptable to MARAFIQ since existing EX2000 can still communicate to Mark Vie using ARCNET to ETHERNET gateway/protocol converter. This information is already provided in "Mark* VIe Control Migration from Mark V Control". So there is no need to upgrade existing EX2000 system of GTG-9. Bidder shall note that there is ARCNET to ETHERNET gateway available with GE for provision of communication of Ex2000 to upgraded MarkVie.
15	Section IV O	EX2100e	2.3	Controls	The Contractor shall conduct feasibility study and suggest suitable latest state of art digital excitation system for existing GTG sets after carefully studying the present arrangement of the excitation system. This feasibility study shall be presented to MARAFIQ representative for their review and approval	Existing AVRs for units 1 to 8 are very old multi-sectional (combination of rotating and stationary AVRs). This system is very old and due to many components, very slow in generator terminal fluctuations. GE's recommendation is to replace all the existing AVRs with static excitation systems. Static exciters, each comes with its own PPT connected to 4160 Unit Auxiliary Transformer (UAT) and static excitation system connected directly to the Generator's main field via the existing brushes. This is provided the UAT size is considered for the power needed by the exciters, because we're replacing rotating exciter with static, the space required for static excitation is needed. Exact dimensions will be given in GE proposal.	Please note the following clauses in SOW: The existing Excitation System can be replaced as whole with sophisticate excitation system such as GE EX2100e Excitation System or equivalent to be compatible with existing GTG sets. It may be replaced with an Excitation Transformer of suitable rating or Single exciter with brush/Brushless type exciter to be matched to our existing generator capacity after conducting feasibility study. The Contractor shall conduct feasibility study and suggest suitable latest state of art digital excitation system for existing GTG sets after carefully studying the present arrangement of the excitation system. This feasibility study shall be presented to MARAFIQ representative for their review and approval.' Hence it is Contractor's responsibility to determine the feasibility of installing a new system after a comprehensive study of existing arrangement to ensure compatibility of the new system with existing interconnections and interfacing requirements.
	ENCHANTE ME	المرافق المرا					المال

13	Arcnet PIOA Card is available only MarkVie Migration solution only. On Full Panel MarkVie upgrade Arcnet communication is not available. So with full panel Mark Vie upgrade, a new EX2100e is required. Please note the existing EX2k is also old and obsolete. So changing it with the latest technology, would be very beneficial in long run.	Closed. Noted. Bidder proposal for replacement of EX2000 is acceptable to MARAFIQ per justification.		Closed
14		Closed. Noted. Bidder proposal for replacement of EX2000 for GTG unit-9 is acceptable to MARAFIQ per justification.		Closed
15	to 8 are combination of many several stages of rotating and non-rotating systems. We're replacing all these different pieces with 2 items, one is the PPT and another is full static exciter lineup. Customer needs to allocate space for the new system as it is replacing many different systems. New line for full redundant exciter (redundant controls and bridges) is 104.3" (2650mm)H x 141.7" (3600mm)W x 34.4" (875mm)D and for partial redundancy (redundant controls/ Simplex bridge) is 104.3" (2650mm)H x 111.7" (2838mm)W x 34.4" (875mm)D. Customer must allocate adequate space for the new exciters and the PPTs.Approximate size of each PPT enclosure is about Enclosed: 64"W x 51.4"D x 75"H	first study the present arrangement, space availability etc. and determine the feasibility of replacing the existing excitation system by Static Excitation System The feasibility study should be comprehensive covering all the technical concerns with respect to existing system and arrangement. Some of the concerns are identified below: 1) What is the implication of the additional PPT load on the UAT? 2)Where is the PPT proposed to be located? GE to identify the location and ensure space availability at site. 3)Where is the Static Excitation line-up of panels proposed to be located? GE to identify the location and ensure space availability in the Auxiliary Control Compartment.(Pls. refer attached drawings) 4)Will the existing SR cubicle be no longer required in view of GE's proposed Static Excitation System? If no longer required, does GE propose to disconnect and remove this equipment? 5) Will the existing AC exciter and Pilot Exciter(HFG) be no longer required, does GE propose to disconnect and remove these equipment? If these are to be removed, how will the bidder accommodate turning gear? (In present Configuration Generator shaft is directly coupled first with Ac exciter, downstream side of AC exciter is connected to pilot exciter and downstream side of pilot exciter is connected to turning gear-Refer the attached drawing#10R-181-392.) 6)How will bidder ensure that removal of AC exciter and Pilot exciter will not affect the dynamic balancing of the rotor system, or affect the units' integrity and reliability in any manner?	1) What is the implication of the additional PPT load on the UAT? Estimates PPT size is 635 KVA for each unit 2) Where is the PPT proposed to be located? PPT will be dry type in an enclosure with approx. size of 64"W by 51.4"D by 75"H and should be placed near 4160 aux bus. Customer will need to provide such space at site. 3) Where is the Static Excitation line-up of panels proposed to be located? Based on the site drawing, there seem to be enough space at the existing SR room IF customer selected dual controls, Simplex bridge EX2100e. But for dual controls/dual bridge we'd need extra 600mm in width. So new space needs to be verified by customer. Else, customer can select dual controls/Simplex bridge and utilize existing space at SR room. 4) Will the existing SR cubicle be no longer required in view of GE's proposed Static Excitation System? If no longer required, does GE propose to disconnect and remove this equipment? New exciter can be placed in the existing SR room in place of existing exciter (if dual controls/Simplex bridge is selected.	Marafiq Response: 1). Noted. This is a significant load. Has GE studied from where to tap this power?? 2) GE has received the General Arrangement Layout Plan of the existing system. They have also visited and surveyed the site many times. Have the identified any vacant space near 4160 V Switchgear to accomodate the required 64"W by 51.4"D cubicle?? 3)Before deciding on the Static Excitation System, GE should determine the overall feasibility of installing the system, taking into account all the technica factors, including layout constraints. Space requirements for all the required equipment are to be verified by GE, and not by MARAFIQ. Dual Thyristor Rectifier Units are required. 4) Refer Point # 3 above. 5)Any exciter equipment, which will no longer be required, should be disconnected and removed. Hence, please propose other alternatives to maintain integrity of the rotating system. 6)Please see response to number 5 above. 7)Please note that the existing 4.16 kV Aux. Switchgear Bus receives power from 3 MVA UAT. It supplies power to 2 MVA Secondary UAT and 670 kW turning gear. So kindly clarify where is the provision for supplying additional 630 KVA load for PPT. If GE is proposing to tap this power directly from generator teriminals, please check the feasibility of the interconnection arrangement and space availability.

16	Section IV O	EX2100e		Controls	Drawings on standard A1 size indicating details and dimensions.	manuals, test reports, etc. from GE will be based on GE	Please refer 'SECTION 01720 - RECORD DOCUMENTS' for format requirements etc. and 'SECTION 01750 OPERATION AND MAINTENANCE MANUALS' comply with the requirements.
17	Section IV O	EX2100e	а	Controls	Digital type Excitation System & D-AVR specification diagram, cubicle out line, schematic for I/F with other equipment,	All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply.	Please see above reply.
8	Section IV O	EX2100e المراكبة الترتاكية الله الله الله الله الله الله الله الل	b	Controls	The Contractor shall submit copies of catalog for all materials and products including manufacturer's certification that the materials complying with the required standards/specifications	All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Marafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply.	Please see above reply. Please see above reply. MARAFIQ PROCLIRIMENT 6 PROCLIRIMENT 6

		The above are just some of the concerns that have been identified. GE should conduct a comprehensive feasibility study to ensure total compatibility with existing arrangement and determine reliability of the new system, before proposing the change in type of excitation system.	downstream side of AC exciter is connected to pilot exciter and downstream side of pilot exciter is connected to turning gear-Refer the attached drawing#10R-181-392.) All existing	Note: In view of the above points, MARAFIQ has major concerns (such as Auxiliary Power supply provision, space availability at site etc.), about the feasibility of installing the Static Excitation System proposed by GE. GE should check whether the offered system is fully compatible with existing system and arrangement. Otherwise, they have to propose alternative solutions, such as the Brushless type Rotating Exciter (as installed in our GTG # 9). It is found that GE is repeatedly commenting 'Customer will need to provide space at site', for the system they are offering. Please note that it is GE's responsibility to study the feasibility of their excitation plan, including layout arrangement. GE's proposal should be supported by a realistic layout plan compatible with the existing space availability at site. MARAFIQ cannot create new space to suit any system offered by GE.
16	All Documents, Manuals, drawings, etc. will be based on GE standard offering. However, minor changes to drawings like Marafiq Logo, numbering, or Titles, can be accommodated. All other changes shall be agreed between GE and Marafiq. Proposed offer shall consider minor changes as stated above in the costing. Other changes (if agreed) will be at extra	Noted .Closed.		Closed
17	Please see above reply.	Noted .Closed.		Closed
18	Please see above reply.	Noted .Closed.		Closed
	1-711/147 (1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-			PROCUREMENT & CONTINACTS DEPI.

19	Section IV O	EX2100e	c	Controls	All materials, cables and wires and other misc. items required on this project shall be submitted for approval before procurement.	All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Marafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply.	Please see above reply.
20	Section IV O	EX2100e	d	Controls	The Contractor shall submit installation/erection drawings for new equipment and demolition drawings for existing to remove under this proposed modification.	All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply.	Please see above reply.
21	Section IV O	EX2100e	е	Controls	The Contractor shall submit installation/erection drawings for new equipment and demolition drawings for existing to remove under this proposed modification.	All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply.	Please see above reply.
22	Section IV O	EX2100e	1	Controls	The Contractor shall submit a detailed method statement for installation and termination of proposed equipment in the panels.	All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply.	Please see above reply.
23	Section IV O	EX2100e	g	Controls	The Contractor shall submit Operation & Maintenance Manual(s), containing of trouble shooting instructions and manufacturer's Recommended Spare Parts List with supporting literatures.	All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply.	Please see above reply.
24	Section IV O	EX2100e	h	Controls	The Contractor shall submit commissioning procedures for commissioning.	All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply.	Please see above reply.
25	Section IV O	EX2100e	4.3.1	Controls	Within fifteen (15) days after the notice of award of the Contract, Contractor shall submit an inspection and testing plan, in two parts, covering off-Site and on-Site activities, for MARAFIQ's review and approval.	Schedule will be determined 4 weeks after customer kick off meeting with Project Manager	To be discussed during kick off meeting.
26	Section IV O	EX2100e	4.3.2	Controls	MARAFIQ reserves the right to witness all or part of testing and inspection activities per approved plan. MARAFIQ or its authorized Representative / 3rd party may witness such activities. Test records shall be submitted for the entire system.	Test reports and other documents will be provided per GE standard manufacturing process and procedures	Please refer 'SECTION 01720 - RECORD DOCUMENTS' for format requirements etc. MARAFIQ ' المقادة الشقريات والتقود المقادة الشقريات والتقود المقادة الشقريات والتقود المقادة الشقريات والتقود المقادة المقادة الشقريات والتقود المقادة

19	Please see above reply.	Noted .Closed.		Closed	
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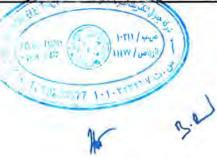
27	Section IV O	EX2100e	4.4.2	Controls	piece of equipment followed by the technical approval of the Preliminary Equipment list (PEL) by MARAFIQ. The Contractor shall promptly update the submittal and proceed in line with procedure.	All documents will be based on GE manufacturing standards.	Please refer 'SECTION 01760 SPARES' and comply with the requirements.
28	Section IV O	EX2100e		Controls	Visual inspection of completed work shall be performed after application. b) Insulation resistance test shall be performed on all electrical and control components and cables. c) Physical checks of all electrical termination and related installation d) Megger the insulation and continuity checks of all wiring to ensure proper connections and grounding	All tests will be based on GE Standard tests applied to such exciters.	Please refer to the applicable testing standards specified in Section IV O,under II -'Technical Requirements" - ' 3. Applicable Codes and Standards', and comply with the requirements. Any deviation from applicable International Standards should be brought out for MARAFIQ's review and approval.
29	Section IV O	EX2100e	5	Controls	Project Description	Existing AVRs for units 1 to 8 are very old multi-sectional (combination of rotating and stationary AVRs). This system is very old and due to many components, very slow in generator terminal fluctuations. GE's recommendation is to replace all the existing AVRs with static excitation systems. Static exciters, each comes with its own PPT connected to 4160 Unit Auxiliary Transformer (UAT) and static excitation system connected directly to the Generator's main field via the existing brushes. This is provided the UAT size is considered for the power needed by the exciters. because we're replacing rotating exciter with static, the space required for static excitation is needed. Exact dimensions will be given in GE proposal.	Please refer our response to Item # 15.
30	Section IV O	EX2100e		Controls	- Digital input Cards (dual cards) - firing pulse control Cards (dual cards) B) Thyristor Rectifier Unit (Power unit) 2 including 1 redundant Field circuit breaker, voltage and current transducers, dischargeresister C) AVR cubicles (Manufacturer's Standards) subject to be approved by MARAFIQ D) Existing PTs, CTs shall be renovated, as necessary, to be reused. E) All necessary materials including wires and cables for new installations, as well as	bridge for units 1 to 8 and redundant controls/redundant bridge for unit 9. Reason for units 1 to 8 having one bridge instead of 2 is because of the limited space available at Marafiq site. GE can provide exactly per spec (redundant controls and bridges) but that will require more space than currently available at Marafiq site. Again, redundant Thyristor rectifier bridges can be provided but in that case the exciters will not fit the existing space at Marafiq site as redundant bridge means larger excitation system and that means more space needed. The existing exciter space at Marafiq site is very limited. So GE recommendation is to go with Redundant controls, Simplex bridge on exciters so to minimize space requirement. If redundant bridge is absolutely required, GE will provide that but customer would need to make sure adequate space is provided for dual	Please note that 'REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM' is required only for TG UNITS 1, 2, 3, 5, 7 & 8, and not for Unit 9. The requirement is for 'dual redundant' Digital type Automatic Voltage Regulators. Any deviation to this requirement will not be acceptable, unless and until there is a valid technical justification. As part of Contractor's engineering responsibility, GE should verify in detail the space requirement for the specified system with respect to space availability at site. Please refer the following clauses also in Section IV - O: 2. 2 The engineering and design responsibilities, under this Contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/ drawings by utilizing technical documents from the Owner's files. 2. 3 The Contractor shall conduct feasibility study and suggest suitable latest state of art digital excitation system for existing GTG sets after carefully studying the present arrangement of the excitation system. This feasibility study shall be presented to MARAFIQ representative for their review and approval.







27	Please see above reply.	Noted Closed.	Closed
28	All tests will be based on GE Standard tests applied to such exciters. Such tests have been approved by factory engineering and have been exercised for all exciters sold globally all over the world. Our tests takes into consideration test of all aspects of the equipment. So no customized test will be acceptable unless already accepted by GE factory.	Noted.Closed.	Closed
29	same as 2.3 (line 30)	Please refer our reply to Point # 15.	No Reply .
30	selected for unit 9 MarkVle. Space for new exciters must be provided for all units. For	Noted and Closed for GTG 9. Existing AVR for GTG 1-8 is located in auxiliary control package. Bidder shall utilize the existing space for AVR replacement. Please refer the attached layout drawing of auxiliary control compartment#331DF1584 for dimensions and maintenance access of existing AVR cubicle.	Closed





31	Section IV O	EX2100e	8.3	Controls	The system cubicle shall be metal enclosed with accessibility from front and rear, including necessary wiring, terminals, and switches or circuit breakers. Internal power, ground, and control buses, connectors, fuses, terminal blocks, name plates, permissive control switches with indicating lights, shall be included. All internal devices for external connections shall be wired to terminal blocks with block and points suitability labeled. Controls circuits for the various components and functions shall be provided with the fuse disconnect switches	Exciter cubicles will have front access.	Accessibility should be from both front and rear.
32	Section IV O	EX2100e	8.9	Controls	The power part of Digital Automatic Voltage Regulator with appropriate ratings shall be provided with the following components: A. Thyristor Rectifier Unit B. Field Circuit Breaker C. Monitoring Devices		Noted. However this should be brought out as a 'Deviation' in the proposal with a valid technical justification, and confirmation of no adverse impact on the functionality, operability or reliability of the system.
33	Section IV O	EX2100e	9	Controls	Non Material Requirements	All deliverables (documents, elementaries, drawings,	Please refer 'SECTION 01720 - RECORD DOCUMENTS'
		Laurenberg				certificates, FAT tests, test reports, etc.) will be based on GE standard documents.	for format requirements etc.
34	Section IV O	EX2100e		Controls	The non-materials requirements for the enhancement of this stepping automation system shall include but not limited to the followings;	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
35	Section IV O	EX2100e		Controls	All composite Engineering packages, materials procurement proposals, manufacturing and test procedures and schedules.	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
36	Section IV O	EX2100e	li	Controls	Software and Hardware package.	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
37	Section IV O	EX2100e	10	Controls	Power and / or control schematic diagrams.	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
38	Section IV O	EX2100e	iv	Controls	Sequence / logic diagrams	deliverables.	Please see above.
39	Section IV O	EX2100e	V	Controls	Wiring diagrams.	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
40	Section IV O	EX2100e	vi	Controls	Specification and Data Sheets.	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
41	Section IV O	EX2100e	Vii	Controls	Complete parts data package	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
42	Section IV O	EX2100e	viii	Controls	Installation and erection instructions	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
43	Section IV O	EX2100e	ix	Controls	Certified test reports, certificates, data and curves	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
44	Section IV O	EX2100e	×	Controls	Operating instructions.		Please see above.
45	Section IV O	EX2100e	xi	Controls	Maintenance manuals / instructions	deliverables. All items I to xiii will be based GE standard documents and deliverables.	Please see above.
46	Section IV O	EX2100e	xii	Controls	Bill of materials	All items I to xiii will be based GE standard documents and deliverables.	Please see above.
47	Section IV O	EX2100e	xiii	Controls	All documents and associated drawings shall be in accordance with the latest revisions of applicable codes and standards.	All items I to xiii will be based GE standard documents and deliverables.	Please see above. MARAFIO PROCUREMENT & CONTRACTS DEPT.

31	Exciter cubicles will have front access only as it is designed for front access. There is high voltage bridge and so it cannot have front and rear access. Pretty much all exciter companies in the world have their exciters designed with front -access only.		Closed
32	Confirmed. New design replaces older Field breaker functionality and will not affect functionality of the new exciter.	Noted .Closed. (Electrical to concur)	Closed
22	anno an line 24	Noted Cleared	Olassad
33	same as line 31	Noted .Closed.	Closed
34	Please see above reply.	Noted .Closed.	Closed
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45	Please see above reply.	Noted .Closed.	Closed
46	Please see above reply.	Noted .Closed.	Closed
47	Please see above reply.	Noted .Closed.	Closed MARAFIO MARAFIO PROCUREMENT 8 PROCUREMENT 8 CONTRACTS DEPT.

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48	Section IV O	EX2100e	11	Controls	Since all units 1 to 8 are identical, Customer witness Factory Acceptance Test (FAT) for one unit is included in base scope of supply.	
49	Section IV O	EX2100e		Controls	Acceptance Test (FAT) for one unit is included in base scope of supply. FAT tests will be based on GE standard tests	Please refer to the applicable testing standards specified in Section IV O,under II -'Technical Requirements" - ' 3. Applicable Codes and Standards', and comply with the requirements. Any deviation from applicable International Standards should be brought out for MARAFIQ's review and approval.
50	Section IV O	EX2100e	11.2	Controls	equipment.	Please refer to the applicable testing standards specified in Section IV O,under II - Technical Requirements" - '3. Applicable Codes and Standards', and comply with the requirements. Any deviation from applicable International Standards should be brought out for MARAFIQ's review and approval.

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48	Closed	closed	Closed
49	Please refer to GE proposal which lists all the standards that GE controls meet. These are globally accepted standards and have been accepted by Marafiq as well in Jubail site.	Noted .Closed.	Closed
50	Noted	closed	Closed
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51	Section IV C	Mark Vie		Controls	SIL2, SIL3 Instrument Protective Functions are Independent and provided in separate	Mark Vies Capable Panel can achieve these SIL levels with compliance to IEC 61508.MarkVies is certified by EXIDA.MarkVie can comply IEC 61511 requirements, But complete Loop compliance for IEC61511 is customer scope.	Bidder (EPC Contractor) shall be responsible for complete loop compliance per IEC61511 for GTG. See attached response. MARAFIQ has to follow safety and security directive to comply with mandatory requirement of HCIS(High Commission of Industrial Security) as per Kingdom Law. Applicable Safety directive is SAF-11. Emergency Shutdown system and its compliance is directly referred in this safety directive. MARAFIQ has to legally implement compliance of SAF-11(Emergency Shutdown, Isolation and Depressuring). See MARAFIQ guide specifications#MQ-SP-I-7010. PHA and HAZOP Study was never performed since from the installation of Gas Turbine Generator. MARAFIQ did not have CAUSE and EFFECT diagram developed for the present set up of gas turbine equipment. MARAFIQ has asked bidder specifically to include determination of SIF based on site equipment configuration and company specific risk matrix in compliance with IEC61511 as per SAF-11. MARAFIQ asks GE to explain the compelling reasons for not being able to provide HAZOP and SIL assessment as scoped and thereby compliance to IEC61511.
52	Section IV C	Mark Vie	5	Controls	Contractor shall provide Turbine Historian either in each HMI's of each GTG 1 to 9 or provide one (1) number suitable GE HISTORIAN SERVER machine with GE Turbine Historian software installed for historian purposes of all GTG's 1 to 9.	GE Has proposed a Common PI Historian for all GT1-9 Units.	Noted. Proposed common PI historian for GTG1-9 is acceptable.
53	Section IV C	Mark Vie	26	Controls	retrofit/replacement shall be the exact	New mark Vie Cabinet size will be different to those existing.900x900x2300 for simplex and 1350x900x2300 for TMR	Noted. However bidder to provide the proposed Mark Vie panel of TMR and SIMPLEX control system for required door opening clearance dimension. This is required to verify that door opening does not pose any clash or interfere with other panel installed near by existing Mark V panel.
54	Section IV C	Mark Vie	27	Controls		Any Field Instrumentation errors or mechanical Issues that are not part of GE scope will be excluded	Noted.
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51	subcontractors to HAZAOP study and SIFs identification. HAZAOP study and SIL identification is included in GE scope. Based on the number of SIFs certification each SIF will be provided on Time rates as change order scope.	MARAFIQ understands that bidder/GE has already carried out the HAZOP and SIL assessment on the GE Gas turbines as an island units. We also understand that GE HAZOP and SIL assessment reports of island units will be made available as input to the studies(HAZOP & SIL) that would be carried out by GE appointed certified third party for combined cycle (i.e. any one of the two	is no SIL capable Design for MarkVie Available for Simplex or Dual controller with Simplex IO systems. Only MarkVie SIL capability is available on TMR MarkVie Systems	
52	Closed	closed		Closed
53	Noted. Details will be provided in technical	closed		Closed
	proposal.			
54	Closed	closed		Closed
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3	55	Section IV C	Mark Vie	30	Controls	Contractor shall warranty the GTG 1 to 9 MARK V replacement with state-of-art MARK VIe or latest revision under the scope of supply for one (1) year after initial acceptance. All Technical Bulletins related to GTG 1 to 9 MARK VIe shall be provided with clear written instruction for MARAFIQ consideration during the period of warranty and after at no cost to MARAFIQ	GE standard warranty 18 months from Delivery or 1 Year from Initial Acceptance.	Noted.
	56	Section IV C	Mark Vie		Controls	The Contractor shall study the SOE (sequence of events) configuration of GTG 1-8 and GTG-9. SOE configuration in GTG1-8 and GTG-9 needs to be studied for all associated electrical protection signals trips and such shall be provided in new upgraded Mark Vie. All additional Input/Outputs hardware, Terminal Blocks, Modules, Interposing Relays and wiring shall be provided for all associated electrical protection signals causing the trips. Accordingly UCS SOE shall be modified by ABB to meet the Mark Vie upgrade. The Contractor shall provide the detailed technical description along with BOM for SOE upgrade of Mark V to Mark Vie in their bid document.	Need clarity on the requirement here.	PHA and HAZOP Study was never performed since from the installation of Gas Turbine Generator. MARAFIQ did not have CAUSE and EFFECT diagram developed for the present set up of gas turbine equipment. However during UCS upgradation, SOE points were configured and developed in Mark-V and UCS. There are no back up documents and basis available for present equipment configuration. All contributing points for SOE which are responsible for causing trip actions must be included for post trip review analysis. All such points (additional Input/Outputs hardware, Terminal Blocks, Modules, Interposing Relays and wiring shall be provided for all associated electrical protection signals causing the trips). Accordingly these new SOE points which are being exchanged through serial Modbus to UCS shall also be modified and configured by ABB to reflect all the changes in UCS so there is no discrepancies of SOE generated.
•	57	Section IV C	Mark Vie	44	Controls	Protective Function) for retrofitting of proposed Mark Vie control system in compliance with Standards IEC61508 and	Fo Gas turbine control GE has defined SIFs amd Mark Vies system Can be provided for SIL Capability. But SIFs determination Hazop Study, SIL assessment and making each SIF Loop Compliant to IEC61511 is out of GE scope of supply.	PHA and HAZOP Study was never performed since from the installation of Gas Turbine Generator. MARAFIQ did not have CAUSE and EFFECT diagram developed for the present set up of gas turbine equipment. Bidder has to conduct HAZOP STUDY, SIF determination, SIL assessment and making SIL Loop in compliance with IEC61511 as per RFP, HAZOP Study shall be conducted based on company risk matrix. This is the mandatory requirement. Exclusion of HAZOP study, SIF determination, SIL assessment and making SIL Loop in compliance with IEC 61511 is not acceptable to MARAFIQ. Bidder can hire/approach sub-contractor or specialist to conduct HAZOP STUDY and carry out SIF determination, SIL assessment and making SIL Loop in compliance with IEC 61511 for the proposed project. MARAFIQ asks GE to explain the compelling reasons for not being able to provide HAZOP and SIL assessment as scoped and thereby compliance to IEC61511. See MARAFIQ guide sepcification#MQ-SP-I-7010.
1	58	Section IV C	Mark Vie		Controls	Before commencing the work contractor shall submit Shop Drawings on standard A1 or A3 size indicating details of design, plans and dimensions. All shop drawings shall be in MICROSTATION format. Contractor shall coordinate with Marafiq Documentation Center for all documentation requirements.	Microstation A3 or A4 drawings will be provided.	Noted. However note that required drawing size shall be minimum of A3. Noted. However note that required drawing size shall be minimum of A3. MARAFIO 10. PROCUREMENT & CONTRACTS DEPT.

55	Closed	closed		Closed
56	identification. HAZAOP study and SIL identification is included in GE scope. Based on the number of SIFs certification each SIF will be provided on Time rates as change order scope.	SIL assessment on the GE Gas turbines as an island units. We also	is no SIL capable Design for MarkVie Available for Simplex or Dual controller with Simplex IO systems. Only MarkVie SIL capability is available on TMR MarkVie Systems only.	Principal to the transfer of
57	identification. HAZAOP study and SIL identification is included in GE scope. Based on the number of SIFs certification each SIF will be provided on Time rates as change order scope.	SIL assessment on the GE Gas turbines as an island units. We also understand that GE HAZOP and SIL assessment reports of island units will be made available as input to the studies(HAZOP & SIL) that would be carried out by GE appointed certified third party for combined cycle (i.e. any one of the two		We would also like to inform GE that in MARAFIQ we follow Layer of Protection Analysis (LOPA) for SIL assessment and would request GE to
58	Closed PSII / Sur-	closed		Closed Closed ANARAFIO MARAFIO PROCUREMENT & PROCUREMENT & CONTRACTS DEPT.

59	Section IV C	Mark Vie		Controls	MARAFIQ reserves the right to witness all of testing and inspection activities per approved plan. Test records shall be submitted for the entire system	other Panels will be tested as per internal test procedures only.	Noted. Customer witnessed test shall include one test for the MarkVie simplex control system GTG1-and second test for TMR of GTG-9.
60	Section IV C	Mark Vie	4.5.6	Controls	It is highly desirable that Generator Protection (relays) System and the Excitation Control System (A VR) should be acconunodated in the existing panel. However, if it is not possible then the CONTRACTOR should discuss the location of new panels with the COMPANY and should submit the location drawings with the proposal.	GPP will use the same existing GCP panel (like GT1-6). AVR control does not need to be placed in the GCP panel. It will be in same lineup as the exciter and will be placed in the same existing exciter compartment. However operation and control of the exciter and monitoring will be done from the local control rooms and main operator rooms.	Noted.
61	Section IV C	Mark Vie	4.6.1	Controls	associated with 3 - Parts of the project (as mentioned below) after	All GE equipment will be tested before shipment and at the site during the installation and commissioning. All tests will be GE standard tests made specifically for such controls and power plant applications.	Noted.
62	Section IV C	Mark Vie	4.6.8	Controls	The functional check/test for all equipment should be made by making trip test and inter-locking test as and where applied as per drawing I OEM standards and to the entire satisfaction of COMPANY	GE standard procedure will be applied.	Noted.
63	Section IV C	Mark Vie	4.7.3	Controls	The licensing for all provided software's shall be the responsibility of the CONTRACTOR, used by the plant personnel for the Plant Operations, Plant Maintenance, Engineering, Printing, Maintenance Archiving and other related applications covering all the Operating Software's, Special purpose software's, Antivirus and all other supplied software's used for the above said applications with dongles and keys required to activate or enable them for the whole plant life.	Antivirus valid license only for 1 year.	Noted.
64	Section IV C	Mark Vie	4.7.4	Controls	The technical upgrades I updates, tabloid, brochures etc. be provided to COMPANY from time to time as are circulated for users, relating to the control, excitation, protection system.	All can be downloaded free from GE web site.	Bidder shall provide all technical upgrades, tabloids, brochures etc as part of project. Bidder's response is not acceptable since documentation is part of bidder's responsibility to provide as per RFP





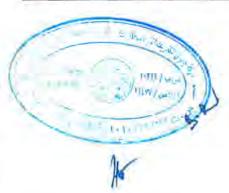
59	Noted	closed	Closed
60	Closed	closed	Closed
61	Closed	closed	Closed
62	Closed	closed	Closed
63	Closed	closed	Closed
64	Will be included	closed	Closed







65	Section IV C	Mark Vie	4.8.2	Controls	The CONTRACTOR shall submit to the COMPANY for review and approval, a complete plan for CONTRACTOR's factory and site acceptance testing for all three parts of the CONTRACT including main and sub-systems. This plan must be complete and having sufficient detail to indicate the exact nature of each test, time required, expected results and step by step procedure. The plan shall include reliability testing of hardware and software. The plan shall be submitted at least two months in advance to allow sufficient time for review and approval. The CONTRACTOR shall record and document all test results and maintain a complete record of all tests and data and submit to the COMPANY at the end of the tests.	Factory Acceptance Test (FAT) for the excitation system is a combination of customer Hardware with a pre-automated S/W to check all the hardware. Also customer S/W with a hardware simulator to check the S/W. The entire Hardware part and Software part will be in 2 working days at the GE facility in the US. Customer witness FAT is already included in GE proposal as a base scope for 2 units as requested in Spec. However, the FAT procedure and tests will be based on GE standard FAT tests that are applicable to such Excitation system. Please note all units will undergo same GE internal FAT. a Repeated FAT will take place with customer presence on the first unit.	Noted.
66	Section IV C	Mark Vie	4.8.3	Controls		of supply. Buyer need to include in their scope. Please note since these two controls are manufactured in different location, FATs will be done on each of the controls	Bidder shall include all the charges for Company Engineers incurred towards transportation and accommodation for FAT. This is the procedure followed in MARAFIQ. Conducting separate FAT test individually for Mark VIe and Excitation System is acceptable. Bidder shall quote charges for integrated FAT test for MARAFIQ Engineers to witness the working of the system satisfactorily as an optional.
67	Section IV C	Mark Vie	4.8.11	Controls	CONTRCTOR shall perform complete performance test of the control system, excitation system for each GT.	All Factory and site tests will be performed based on GE manufacturing standard tests which are applicable to such application and exciters	Noted.





Noted	Closed
closed	closed
Closed	Closed



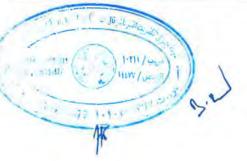


68	Section IV C	Mark Vie	4.10.8	Controls	GT Units shall be tested for startup, shutdown, full speed no load, Load Acceptance, Load Rejection and other related tests to prove correct protection & control for the period mentioned in Technical Completion Requirements. GT Units shall be safe in all operating conditions, on actual fault, GT Units should be safely shutdown at determined protections & settings, false tripping of control excitation & protection shall be requiring rectification before declaring Technical Completion by the CONTRACTOR	All Factory and site tests will be performed based on GE manufacturing standard tests which are applicable to such application and exciters	Noted.
69	Section IV C	Mark Vie	а	Controls	Operation & Maintenance Manuals: 6 sets (both hard and soft copies for each portion separately) of operation and maintenance manuals which should give clear elaboration of maintenance aspects of the supplied equipment. It should also contain step by step information's for parts replacement technique	O&M Manuals applicable for Upgrade portion only.	Noted.
70	Section IV C	Mark Vie	uı	Controls		Interconnection wiring drawings, cable lists are out of GE scope. Buyer need to provide these.	Bidder scope includes preparation of interconnection wiring drawings, cable lists. Existing interconnection wiring drawings are provided as per list in reference drawings. Bidder shall retrieve all the existing reference drawings from MARAFIQ documentation center.
71	Section IV C	Mark Vie	4.11.5	Controls	Three (3) sets of software's (multi used) not for one time used, on CDs are required from the CONTRACTOR for complete installations of the supplied software including the patches with applicable anti-virus with the applicable procedure for installation, configuration of the supplied systems and equipment's	GE standard sets of software will be supplied.	Noted
72	Section IV C	Mark Vie		Controls	The CONTRACTOR's under the scope of this PROJECT shall provide a complete Priced list of operational spare parts for two (2) years of service I operation as per Pricing Attachment of the Bid Form as optional. The CONTRACTOR shall submit the recommended operational spare part lists indicating the installed quantities, recommended quantities and unit prices.	Pricing list will be provided in optional scope	Noted.
73	Section IV C	Mark Vie	iv	Controls	Site Training of 5 days for Ten (10) days COMPANY Personnel for GT#3SFC.	Training For SFC is excluded.MarKVie Training is quoted above.	Please confirm the meaning of "SFC". As per our understanding SFC stands for Sequential Function Chart. Training for SFC is required.
74	Section IV C	Mark Vie	Attachmen t-l	Controls	DRAWINGS, STANDARDS, SPECIFICATIONS AND CALCULATION SHEETS	GE standards will apply.	Bidder shall provide drawings, standards, specifications, O&M manuals and calculation sheets as stated in RFP.





68	Closed	closed	Closed
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			(L)
69	Closed	closed	Closed
	Dr. II		
70	Closed	closed	Closed
71	Closed	closed	Closed
72	Closed	closed	Closed
12	Glosed	olosed .	dissec
73	Noted. Trainings will be provided based on GE standard Training Manuals.	closed	Closed
	GE standard Training Manuals.		
74	Noted	closed	Closed





					GTG Rehabilitation by Replacement of Major Parts, Yanbu		MARAFIC			
bjec t:	Pre bid	clarification # 3					Clarification # 1-193			
EM O.	RFP section	Section Title	Sub-section /paBidder	Related Scope		BIDDER'S CLARIFICATION (May 17th)	MARAFIQ RESPONSE	GE Reply	MARAFIQ RESPONSE	
3	1	INFORMATION TO BIDDERS	1.2	General	MARAFIQ intends to go for GTG frame 7001E rehabilitation by replacing the Major Parts, since all Gas Turbine Generator's rotors have rejiched to 200K and following Major Rems need to be replaced:	Are there defined performance goals that must be met? , 0, 0, 0, 0		1		
)	4	INFORMATION TO BIODERS	1. 4. Bc	General	Climatic Conditions-Air Temperatures Range of monthly maximum 35.1 to 60.0 C Range of monthly minimum 6.0 to 12.00 C Range of monthly mean dal y maximum 25.5 to 35.90 C Range of monthly mean dal y minimum 12.3 to 26.00	Need site fuel gas analysis, pressure and temperature, 0, 0, 0, 0	See the attached Sales Gas Fuel pinalysis.(A-120) Pressure(Max/Min) : 21Barg/18Barg Temp: 65 Deg C	Closed	Closed	
	1	INFORMATION TO BIDDERS	1. 4. C.	General	Relative Humidity Maximum relative humidity 100% Maximum relative humidity 6%	Provided liquid fuel sample is not complete. Please provide full liquid fuel analysis , 0, 0, 0, 0	See the attacheed GTG Fuel analysis data.	Closed	Closed	
	1	INFORMATION TO BIDDERS	1.4.F	General	Loading Time Normal 20 minutes / Fast Load 9.5 minutes	any changes required?, 0, 0, 0, 0	RFP/Tender condition prevals. Bidder to follow RFP requirement.	Closed	Closed	
5	1	INFORMATION TO BIDDERS	1, 4, G.	General	Riade Load, Sales Gas at site (50 C) Simple-cycle Combined-Cycle Base 56, 570 kW 55, 720 kW / Peak 52, 310 kW 61, 370 kW	any changes required?, 0, 0, 0, 0	RFP/Tender condition prevails.Bidder to follow RFP requirement.	Closed	Closed	
		INFORMATION TO BIDDERS	11/9-	General	The Contractor's scope of services shall include the following as a minimum. The scope of services for each task includes complete field survey and verification of existing utility system interfaces, engineering and design services, manufacturing, procurement, coordination/interface with other contractors, construction and testing as well as the provision of associated drainage, erosion control, detours and all pertinent items as described below, and as necessary to complete the work satisfactority. The bidder shall take dismantled Part from Rehabilitation and Available Capital Spares from Marafig Ware house in the Parts Exchange Programme (Whichever applicable). The Contractor shall provide onsite personnel as required throughout the design period to obtain the necessary information. Contractor shall provide on-site personnel, as required, to retrieve information from as-built drawings and other documents at the MARAFIQ Library, required for preparation of designs, drawings and specifications for the work under this Contract. On-site personnel shall include a minimum of one engineer with experience of GTG plants from initiation of design through the intermediate design submittal and review. In addition, the Contractor shall assign an on-site coordinator during the entire design phase. The preparation and submission of design, construction and shop drawings, specifications, system analysis, studies, calculations. DCS documents, product data and samples pertaining to all engineering disciplines, for review and approval by MARAFIQ. Process system studies and analyses must be performed and presented to MARAFIQ before design drawings are finalized or equipment is purchased. Refer to detailed sow for additional studylanalysis requirements for each item. All design drawings, except existing drawings requiring revisions, shall be prepared by the Contractor using Bentley Micro-station drafting methods. Refer to Technical Requirements and Section 01720 Record Documents. The preparation and submission of cutover pla		RFP/Tender condition prevails. If bidder wants to discuss in details, the list of queries for each point and bidder's understanding towards each query	Still waiting for Marafiq response regarding the infe/condition of parts that was sent separately	No list Received	
3	2	GENERAL REQUIREMENTS	2. 2. C.	General	The work shall comply with applicable Marafiq Specifications and Standards. RC Design Criteria / Guideline Specifications, Industry Codes/standards and shall be based on good engineering practices.	0, GE WILL PROVIDE PARTS TO GE SPECS AND INTERNATIONAL STANDARDS, 0, 0, 0	Noted.	Closed		
4	2	GENERAL REQUIREMENTS	2, 2, D	General	Engineering work shall include but not be limited to Detailed Design of the Work.	Please clarify this statement, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Bidder shall define the battery limit & quantum of the work. All required work shall be assessed in tendering staBidder and during site visit. Based on the site visit, bidder can asses the battery limit and quantum of the work. This clause is applicable to all bidders. So MARAFIQ cannot delete this caluse for bidder's selectively. MARAFIQ follows transparent procedure withourt any inclination	New Batteries will be supplied	Bidder Reply irrelevant, Bidder reply should be about Battery limit & quantur of work.	
5	2	GENERAL REQUIREMENTS	2.2 €	General	Procurement work shall include identification of required materials and equipment, Preparation of Material Take-offs and Purchasing Specifications, PO Placement, Expediting, Material inspection, Delivery of material to site, etc.	GE will procure material per GE quality system in place, 0, 0, 0, 0	Noted. However Bidder Quality system shall comply with MARAFIQ requirement.	Subject to discussion.	Discussion will not bring results on this point Bidder should comply with SOW stated Codes and standards. Any Variation on SOW stated / RFP stated Bidder shall submit deviation from specification under RFP deviation form	
	7	GENERAL REQUIREMENTS	2.2 1.	General	This scope of work describes all the work and work related activities to be carried out by the Contractor. Any specific work or activity inadvertently not included in the scope of work but deemed to be necessary for the successful operation of the installation as intended by this document shall be considered as included in the scope of work of the Contractor.		Noted However RFP/Tender condition prevails	GE scope shall be limited to what has been contracted. Anything additional shall be agreed on as extra work	As per Marafig SOW stated any specification or activity inadvertently not include in the Marafig SOW but deemed to be necessary for the successful operation the installation shall be considered as included in the scope of work of the contractor. For futher detail refer MARAFIQ SOW page no. 18 clause #3.). Any Variation on SO. Stated / RFP stated Bidder shall submit deviation from specification under RFI deviation form.	
0	2	GENERAL REQUIREMENTS	2. 2. J.	General	All design and shop drawings, calculations and such other documents once approved by Maraliq shall not be revised or modified without written prior approval from MARAFIQ.	d .	Noted. Wherever it is absolutely required approval, Bidder has to submit drawings, documents to MARAFIO.	Closed	Closed	
51	2	GENERAL REQUIREMENTS	2. 2. K.	General	It shall be the Contractor's responsibility to select and supply all materials and equipment that have been designed/fabricated for the required service conditions in accordance with all the applicable codes and standards, and the current standards of engineering and workmanship suitable for the intended purpose.	0, MARAFIO TO CONFIRM IF ANY COUNTRILS ARE BLACKLISTED / NOT ALLOWED TO PROVIDE PARTS FOR THIS PROJECT, 0, 0, 0	Equipment manufactured in China are not acceptable Gas-Turbine Biddemeartor equipment (Mechanical, Electrical, instrumentation and control) shall be of Bidder products, manufactured in USA	Noted	- Col	
55	2	GENERAL REQUIREMENTS	2, 2, 0	General	MARAFIQ safety procedures shall be followed during the construction and commissioning period of the project.	II, MARAFIQ AND GE SAFETY ENGINEER TO DISCUSS THE ONE GE PIAN. MARAFIQ SAFETY PLAN AND AGREE ON ONE SAFETY PLAN FOR THE PROJECT, 0, 0, 0	Noted	Closed	Closed 32 MAR	
5	2	GENERAL REQUIREMENTS	2.2.P.	General	The Contractor shall submit the design drawings/documents and materials/equipment purchase requisitions formally to Marafig for review and approval. The procurement shall be carried out only after approval from Marafig.	 GE DRAWINGS/DOCS, STANDARDS, SPI CS SHALL NOT BE FOR APPROVAL SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION, B, B, 0 	Noted: Wherever it is absolutely required approval, flitder him to submit drawings; documents to MARAFIQ. MARAFIQ will identify such requirements and accordingly bilder will be notified.	Closed	Closed June PROCUR	





57	2	GENERAL REQUIREMENTS	2. 7. Q.	General	Contractor shall arrange for power, water, and worker facilities, etc. for their site office, and for Construction and testing purposes.	0. MARAFIC TO CONFIRM WHAT FACILITIES ARE AVAILABLE ON SITE, 0, 0, 0	MARFIQ will provide the space for office and laydown area based on the availability of land and space. Utilities like power, water, amenities, telephone, internet eld will be arranBildderd by bildder. MARAFIQ is not responsible to provide any kind of utility.	Noted	
.58	2	GENERAL REQUIREMENTS	2 Z.R	General	For site office utilities connections, on contracts general conditions GC,17 as well as Mobilization clause requirements, says that contractor is responsible to provide all requirements of utilities connection to his site office and lay down area. In case of contractor needs Marafig to supply him "subject for availability", Cost for providing the temporary utilities shall be borne by the Contractor. Utilities such as electricity and water provided by MARAFIQ shall be on payment basis at the prevailing rates.	GE AND MARAFIQ TO DISCUSS AND AGREE ON LAYDOWN AREA /STORAGE AREA/OFFICE AREA. TO DISCUSS AND AGREE ON UTILITIES, 0.0, 0	MARFIQ will provide the space for office and laydown area absed on the availability of land and space. Utilities like power, water, amenities, telephone, internet etc will be arranBidderd by bidder. MARAFIQ is not responsible to provide any kind of utility.	Noted	
62	2	GENERAL REQUIREMENTS	2. 2. V.	General	Contractor shall submit equipment catalog and shop drawings, project drawings, connection diagrams and other submittals in accordance with the requirements of the applicable standards and subject to MARAFIQ approval prior to the procurement of any equipment and materials.	0. GE DRAWINGS/DOCS, STANDARDS, SPECS SHALL NOT BE FOR APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION, 0, 0, 0	Noted. Wherever it is absolutely required approval, Bidder has to submit drawings, documents to MARAFIQ, MARAFIQ will identify such requirements and accordingly bidder will be notified.	Closed	Closed
64	2	GENERAL REQUIREMENTS	2.2.X.	General	Contractor shall provide a written guarantee covering the materials and workmanship against the latent defects and other physical damages due to the normal wear and tear for a period of one year from the date of acceptance of the work by MARAFIO.	0, GE WILL PROVIDE WARRANTY ON PARTS AND SERVICES PER CONTRACT AGREEMENT. 0, 0, 0	Noted.	Closed	Closed
65	2	GENERAL REQUIREMENTS	2. 2. Y.	General	Contractor shall be responsible that all project drawings, construction materials, equipments, installation and workmanship provided under this contract comply with the contract provisions. Revision or submittals approval by MARAFIQ does not release the contractor from his obligation regarding equipment performance in accordance with applicable codes and standards and specifications.	0, GE DRAWINGS/DOCS, STANDARDS, SPECS SHALL NOT BE FOR APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION, 0, 0, 0	Noted. Wherever it is absolutely required approval, Bidder has to submit drawings a documents to MARAFIQ, MARAFIQ will identify such requirements and accordingly bidder will be notified.	Closed.	Closed.
70	2	GENERAL REQUIREMENTS	2. 4. C.	General	Contractor shall GTG Rehabilitation work to be executed as per Marafiq maintenance plan schedule. The Contractor shall provide detailed Level-III schedule for executing all the works for each GTG in technical proposal.	0, CONTRACT SCHEDULE TO BE DISCUSSED AND AGREED PRIOR TO BID SUBMISSION, 0, 0, 0	Noted.	Closed	Closed
72	2	GENERAL REQUIREMENTS	2.5.A.	General	The contractor and its subcontractors performing work at the site shall be required to comply with and enforce strictly all the required MARAFIQ Industrial Safety rules, regulations and practices.	MARAFIQ AND GE SAFETY ENGINEER TO DISCUSS THE ONE GE plan + MARAFIQ SAFETY PLAN AND AGREE ON ONE SAFETY PLAN FOR THE PROJECT, 0, 0, 0	Noted.	Closed	Closed
73	2	GENERAL REQUIREMENTS	2.5 B	General	The contractor shall coordinate with MARAFIQ industrial Safety section. The contractor shall have deemed to understand all the safety requirements related with the work and is responsible to act upon accordingly.	MARAFIQ AND GE SAFETY ENGINEER TO DISCUSS THE ONE GE plan + MARAFIQ SAFETY PLAN AND AGREE ON ONE SAFETY PLAN FOR THE PROJECT, 0, 0, 0	Noted.	Closed	Closed
75	2	GENERAL REQUIREMENTS	2. 7	General		0, GE DRAWINGS/DOCS, STANDARDS, SPECS SHALL NOT BE FOR APPROVAL, SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION, 0, 0,	Noted. Wherever it is absolutely required approval, Bidder has to submit drawings, documents to MARAFIQ. MARAFIQ will identify such requirements and accordingly bidder will be notified.	Closed	Closed
7.9	2	GENERAL	2. 8. C.	General	Contractor should perform the job within Three year total for Gas Turbine 1 to 8.	0, CONTRACT SCHEDULE TO BE DISCUSSED AND AGREED PRIOR TO BID	Noted.	Closed	Closed
83	2	REQUIREMENTS GENERAL REQUIREMENTS	2, 10	General	The contractor shall be responsible to carry out performance test for all units after completion of commissioning as per the latest revision of performance test Procedure ASME (PTC#22). MARAFIQ will, following delivery of the request by the contractor, witness all required tests and either indicate its acceptance or notify the contractor about the deficiencies which are discovered and are required to be completed by the contractor within mutually agreed time limit. Upon completion of specified deficiencies, MARAFIQ shall either accept or give contractor notice of failure to complete the work or correct the specified deficiencies. Contractor will submit performance curves & calculations to assess the output & Heat rate according to contractual agreement.		Noted	Closed	Closed
84	.2	GENERAL REQUIREMENTS	2, 11	General	The Contractor shall, at all times, keep the work site areas, under its use, in a neat, clean, and safe condition and shall dispose of all rubbish and other unwanted materials. Contractor shall also ensure that the entire project related labor and material employed by contractor are removed from the work site upon completion of the work.		Noted.	Closed	Closed
86	2	GENERAL REQUIREMENTS	2. 12. a)	General	MARAFIQ shall have the right to revise scope of the work items either by increasing the value of work or by reducing the number of scope items. In such cases the contract shall be amended accordingly.	0. DETAILS MUST BE DISCUSSED AND AGREED PRIOR TO BID SUBMISSION, 0, 0, 0	Noted.	Closed	Closed
89	2	GENERAL REQUIREMENTS	2. 13	General	The contractor shall be responsible for protection of the existing installations and preventing any loss caused by personnel or equipment movement while working at site. The contractor shall take every positive action to protect the existing facilities from any damage resulting during implementation of this project. Unless otherwise specifically directed the contractor shall protect all existing facilities from any loss and prevent interruption of the services. The contractor shall be fully responsible for any damage to the existing installations during the execution of work. Any loss, if occurred, shall be repaired and/or replaced, to restore to the original condition, at no additional cost to the owner.	0. GE CANNOT BE RESPONSIBLE FOR EQUIPMENT THAT IS NOT UNDER GE CONTROL, 0, 0, 0	Noted	Closed	Closed
96-	2	GENERAL REQUIREMENTS	2. 14. F.	General	The Contractor Shall Perform Units are dismantled and removed and transported to a designated disposal area approved by Marafiq.	0, CONFIRM LOCATION OF DISPOSAL AREA, 0, 0, 0	MARFIQ will identify and inform you the location of disposil area. This information will be shared with bidders' to part classification.	Closed	Closed
101	3	TECHNICAL REQUIREMENTS	3.3	General	The contractor shall be fully responsible for the damage of any existing facilities during the execution of work any damages, if occurred, shall be built by repairing and/or replacing, to restore to the original conditions, at no additional cost to the MARAFIQ.	0, MARAFIW TO CLARIFY: GE CANNOT BE HELD RESPONSIBLE FOR EQUIPMENT NOT UNIT ITS CONTROL, 0, 0, 0	will be shared with bidders in next clarification. This project is for rehabilitation of existing GTG. Each GTG will be handed over to successful bidder for rehabilitation. Bidder is responsible to preserve and maintain the existing facilities equipment within his battery limit till the completetion of project.	Noted, however Marafiq to ensure the handed over area shall be secured during all times.	Bidder Shall comply Marafig SOW states page no.23 clause no.3 (Protection of existing facilities) Any Variation on SOW stated / RFP stated Bidder shall submit deviation from specification under RFP deviation form.
103	3	TECHNICAL REQUIREMENTS	3.4. a)	General	The contractor shall arrange and provide at its own expenses for all mobilization and demobilization of its equipment and personnel, including, but not limited to, temporary facilities and transportation:	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Tender/RFP condition prevails.	Noted	
104	3	TECHNICAL REQUIREMENTS	3 4 6)	General	Demobilization includes all work related to moving out, upon satisfactory completion of work and shall include removal of equipment, tools, supplies and personnel and disposing of excess materials. It also includes the final submittals of As-Built drawings.	0, GE DEMOBILIZATION WILL BE ON COMPLETION OF THE 30 DAY RTR. AS BUILT DRAWINGS WILL FOLLOW, 0, 0, 0	Tender/RFP condition prevails.	upon 30 days	Bidder Shall Comply Marafiq SOW state page no.23 clause no.4 Mobilization and demobilization) Any Variation on SOW stated / RFP stated Bidder shall submit deviation from specification under RFP deviation form.
106	3	TECHNICAL REQUIREMENTS	3, 6	General	The contractor shall be responsible for the supply and delivery to site of all equipment, materials and supplies require for accomplishing and performing the work.	0. GE PARTS PROVIDED ARE LIMITED TO SCOPE SPECIFIED IN THE BID DOC, 0, 0, 0	Tender/RFP condition prevails	GE will provide all necessary equipment, material and suplies for the contracted work.	Bidder Shall Comply Marafig SOW state page no.23 clause no.6 (Supply and Procurement) Any Variation or SOW stated / RFP stated Bidder shall submit deviation from specification und RFP deviation form.
109	3	TECHNICAL REQUIREMENTS	3.7.72	General	Within ninety (90) days of the Commencement Date, the Contractor shall submit to MARAFIQ for approval a separate Permitting Summary Schedule detailing all activities including but not limited to permit preparation, submittal and approval cycle and the start and finish dates for the progress of these activities. Each permit must be clearly identified as separate line items within the Permitting Summary Schedule. The Contractor shall also produce and issue to MARAFIQ a detailed permitting activity schedule at individual permit level. This shall be maintained up to date by Contractor and resued to MARAFIQ on a monthly basis.	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0, 0	Tender/RFP condition prevails.	knowing all requirements before	Bidder Shall Comply Marafiq SOW state page no.23 clause no 7.1 (Schedule & Progress report) Any Variation on SOW stated / RFP stated Bidder shall submit deviation from specification under RFP deviation form







112	4	TECHNICAL REQUIREMENTS	77.75	General	If at any time MARAFIG is of the opinion that the progress of the Works is delayed such that the Works are unlikely to be completed by the Time for Completion or that a Milestone Date will not be complied with (after taking account of any extension of time granted under Special Condition SC-2 "Commencement and Completion") MARAFIG shall be entitled to require Contractor to submit within 14 days a revised Schedule demonstrating Contractor intends to reorganize the Works in order that completion within the Time for Completion and/or compliance with Milestone Dates can be achieved (the "Recovery Plan"). In any case if the progress update indicates the Works is fourteen (14) or more calendar days behind the current Schedule, Contractor shall submit a Recovery Plan indicating means by which Contractor intends to regain compliance with the Schedule. All remaining activities shall be re-scheduled based on the remaining duration for each activity. Remaining duration values must be realistic and reflect the previous recorded progress. The Recovery Plan shall include a revised manpower histogram showing realistic personnel resource levels in line with the remaining duration. Under no circumstances shall the Recovery Plan indicate a revised Time for Completion or Milestone Dates without prior approval and agreement from MARAFIQ. The revised baseline Schedule along with the proposed Recovery Plan, critical path analysis, manpower deployment histogram (Revised & Original) and other planning reports shall be submitted to MARAFIQ for approval. Contractor shall ensure that all the above-mentioned reports substantiate the Recovery Plan, all planning and scheduling reports shall be corrected to reflect revised percentage progress and plan. The Works shall be re-basing lined to reflect the revised Schedule.		Elidder's understanding is correct.	Closed	Closed
127	3	TECHNICAL REQUIREMENTS	3, 8, 8.4	General	Contractor shall provide training on site for MARAFIQ O&M personnel. Training shall be conducted by qualified & competent personnel who are thoroughly knowledgeable with the theory, operation and maintenance of the new equipment.	0, 0, Training list to be agreed between Ge/Marafiq, 0, 0	Bidder's understanding is correct.	Closed	Closed
28	3	TECHNICAL	3. 8. 8.5	General	Contractor shall provide special maintenance tools for all discipline works.	0, 0, GE can provide special maltenance tools for turbine and generator, 0, 0	Confirmed.	Closed	Closed
41	3	TECHNICAL TECHNICAL	3. 11. 11.5	General	Tag Description of equipment - following the Marafig standard	0, WHAT IS MARAFIQ STANDARD, 0, 0, 0	MARAFIQ will provide MARAFIQ guide specifications and procedure for Tag	Closed	Closed
42	3	REQUIREMENTS TECHNICAL	3. 11. 11.5	General	Equipment Type - following the Maralig standard	0, WHAT IS MARAFIQ STANDARD, 0, 0, 0	description of equipment for entering data into SAP. MARAFIQ will provide MARAFIQ guide specifications and procedure for Tag.	Closed	Closed
	-	REQUIREMENTS		111111		A CONTROL OF THE CONT	description of equipment for entering data into SAP.	Y 30	W 9 7
43	3	TECHNICAL REQUIREMENTS	3, 11, 11,5	General	Discipline of equipment - following the Marafiq standard	0, WHAT IS MARAFIQ STANDARD, 0, 0, 0	MARAFIQ will provide MARAFIQ guide specifications and procedure for Tag description of equipment for entering data into SAP.	Closed	Closed
156	3	TECHNICAL REQUIREMENTS	2. 11. 11.7	General	The minimum data required for Maintenance Strategies as detailed above (2.3) shall be documented following the appropriate Marafig standard format for entry into the SAP system and Document Control Standard. Documents relating to Maintenance Strategies shall be formative transmitted to Marafig no later than the specified dates detailed in the Project Plan. This requirement shall include hardcopy and soft copy originals documentation, in the formats defined in Marafig Document Control Standards, at various stages in the project, for example Concept, FEED, IFC and As Built etc.		Drawing shall be in Micro Station format.	GE-designed equipment will have drawings issued per the GE standard (Ungraphics). Interconnect piping, cable routing, etc, can be done in the	Bidder Shall Comply Marafiq SOW stated page no.39 clause no.14 (Documentation for Marafiq Review and Approval) Any Variation on SOW stated / RFP stated Bidder shall submit deviation from specification under RFP deviation form.
55.5		TECHNICAL TECHNICAL	3. 12. 14.1	General	The Works shall be carried out in accordance with the relevant Standards and Codes. The Codes and Standards listed below shall be considered as an integral part of the Scope of Work. Where discrepancy i inconsistency exist between these Codes and Standards, the most stringent application shall govern. Discrepancy shall be brought to the attention of Marafig Representative prior to start of the activity. The Contractor shall ensure that the requirements of the Standards are compiled to, and that all applicable material and design requirements, tests, inspections and other requirements are compiled. Royal Commission Standards Royal Commission (RC) Design Criteria. RC Guideline Specifications, RC Environmental Regulations are to be followed for the execution of the Project wherever applicable, unless Otherwise specifically mentioned in the Scope or Specifications. Comply with the applicable provisions of the codes and standards of the following Organizations: OSHA OCCUPATIONAL SAFETY AND HEALTH ASSOCIATION SASO SAUDI ARABIAN STANDARD ORGANIZATION ASTM AMERICAN SOCIETY OF TESTING AND MATERIALS AWS AMERICAN WELDING SOCIETY ANSI AMERICAN WELDING SOCIETY ANSI AMERICAN WELDING SOCIETY ANSI AMERICAN SOCIETY OF MECHANICAL ENGINEERS ASME AMERICAN SOCIETY OF HEATING REFRIGERATING AND AIR CONDITIONING ENGINEERS SMACNA Sheet Metal and Air Conditioning Contractors' National Association SSPC STEEL STRUCTURE PAINTING COUNCIL PIC-B-1216 INSTRUCTION MANUALS FOR GAS TURBINE GENERATORS NFPA 70 NATIONAL ELECTRIC CODES FM FACTORY MUTUAL ENG. CORP. RC-MYAS ROYAL COMMISSION GUIDELINE SPECIFICATIONS RC-ER ROYAL COMMISSION BINDRONMENTAL REGULATIONS IEEE INSTITUTE OF ELECTRICAL AND ELECTRICOLES HIGH BIRLS SPECIFICATIONS All materials and equipments furnished in accordance with this specification shall also comply with	GE DRAWINGS/DOCS, STANDARDS,SPECS SHALL NOT BE FOR APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION, 0, 0, 0 GE DRAWINGS/DOCS, STANDARDS,SPECS SHALL NOT BE FOR	Noted. Wherever it is absolutely required approval, Bidder has to submit drawings, documents to MARAFIQ. Noted. Wherever it is absolutely required approval, Bidder has to submit	Closed	المراه المراع المراه المراع المراه ا
EΩ	3	REQUIREMENTS	3, 12, 14,1	General	All materials and equipments turnished in accordance with this specification shall also comply with latest edition of the following sections of the Marafig guide specifications:	APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION, 0, 0, 0	drawings , documents to MARAFIQ.	Closed	Closed
24	3	TECHNICAL REQUIREMENTS	3. 12. 14.2	Genéral	All materials and equipments furnished in accordance with this specification shall also compty with latest edition of the following sections of the RC MYAS guide specifications. Refer to the tables in pages 37 -38	0, GE SUPPLIED EQUIPMENT IS NOT FOR APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXCUTION. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION, 0, 0	Noted. Wherever it is absolutely required approval, Bidder has to submit drawings , documents to MARAFIQ.	Closed	Closed
25	. 1	TECHNICAL	3, 13	General	The duration of the contract for the total completion of the Project will be Thirty Six (36) Gregorian	0, DISCUSS AND AGREE CONTRACT DURATION, 0, 0, 0	Tender/RFP condition prevails		No project Schedule received from
		REQUIREMENTS			months from the Notice to Proceed. This duration shall include design & approvats, Procurement. Construction, Obtaining permits, Installation. & Testing and Commissioning, and O&M Manual submission, including integration with the existing or new systems/projects. The contractor shall recommended the Maximum shop prefabrication is required to minimize field erection labor and provide specific details of field tasks required to erect the Equipment.			per submitted project schedule.	l Bidder
2II	3	TECHNICAL REQUIREMENTS	3. 15	General	The Contractor shall comply with the Marafig safety procedures outlined in Attachment A – General Terms and Conditions Section from section GC 25 to GC 32 inclusive	D, DISCUSS AND AGREE THE ONE GE PLAN AND MARAFIQ SAFETY. REQUIREMENTS, 0, 0, 0	Tender/RFP condition prevails	Noted. Agreement on One GE plan shall be established during the Kick off meeting	Bidder shall comply with the Marafiq Safety procedures outlined in Attachment A - General Terms and conditions section from section GC.25 to GC.32 inclusive. Any Variation on SOW stated / RFP stated Bidder shall submit deviation from specification under RFP deviation form. (Refer page no 15 of 15 in Form of

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2.50	3	TECHNICAL REQUIREMENTS	2 16 B	General	Installation of NOX Control System for GTG Units 1 - 8.	0 CONFIRM LOCATION OF SKIDISKIDS, 0, 0 0	Localian Nox Control system skid shall be decided based on the options finalize after bidding process. However, Water injection skid will be centralized as clashfed to bidders' in preb d meeting and recent site survey. Gas Control module will be installed 3 meter away near accessory compariment.	d GE will provide a water injection skid per unit considering the limited space available	Eldder can submit their preliminary layo on same.
237	3	TECHNICAL REQUIREMENTS	3. 16. 1.	General	Replacement of exhaust plenum for GTG units 1-8.	0. PROVIDE DRAWINGS OF EXHAUST SYSTEM, 0, 0, 0	MARAFIQ has already provided exhaust plenum drawings in reference drawings	Closed	Closed
249	3	TECHNICAL REQUIREMENTS	3. 16. Ü.	General	GTG Performance Test and Training	0, WHAT IS THE REQUIREMENT, 0, 0, 0	Performance test and training is required to confirm the performance and efficiency of each GTG unit with and without HRSG. MARAFIQ shall assign their employees for training for conducting performance test and training	Closed	Closed
250	3	TECHNICAL REQUIREMENTS	3. 16. V	General	Training to MARAFIQ Staff	0. WHAT IS THE REQUIREMENT, 0. 0, 0	Training is required for each GTG unit like Mark Vie. Exciter , Mechanical	Closed	Closed
252	4	Detailed Scope Of Work	4. A	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8		0, MARAFIQ CLARIFY: CONFIRM LOCATION FOR REPLACEMENT SKID, 0, 0, 0	Equipment, electrical equipment As discussed and finalized, replacement skid will be located in existing skid location.	Closed	Closed.
254	4	Detailed Scope Of Work	4 A. 1	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	The existing unit installed in 1982 has completed 30 years of service and have been deteriorated due to corrosion and long service title. Especially during summers, Marafiq experiences turbine trips on high tube oil (emperature (exceeding alarm set point 74°C) & high hydrogen gas temperature (exceeding alarm set point 80°C due to poor heat transfer across radiator (just 1 deg.C drop of cooling water temperature) due to excessive deposit on tube fins. Also the radiator skid structure is de-laminated and corroded.	0, MARAFIQ CLARIFICATION: MARAFIQ TO PROVIDE DRAWINGS BEFORE BID SUBMITTAL, 0, 0, 0	Bidder to refer the reference drawings provided with RFP.	Closed	Closed
255	4	Detailed Scope Of Work	4 A. 1	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-9	Marafiq is considering replacement of complete "Turbine & Generator Radiator cooling water skid system" along with skid structure and auxiliaries as a package unit with a new unit for each Gas Turbine Generators (for GTG 1 to 8). The existing 56.2 MW Gas Turbine Generators Frame 7001E (for GTG 1 to 8) is Hilachi Manufactured, licensed from GE, Further, each of the two gas turbines is connected to one HRSG. The proposed modification consists of	Does marafiq want the same as what is installed in GT9?, 0, 0, 0, 0	MARAFIQ wants single skid for each GTG unit similar to GTG 9 with three lans and two pumps for replacement skid. Single skild shall be capable to provide colling wtaer for turbine and Biddemerator of each GTG unit.	Closed	Closed
256	4	Detailed Scope Of Work	4. A. T	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Installing the new complete radiator skid.	0, IS A CHEMICAL DOSING POT REQUIRED FOR ALL UNITS, 0, 0, 0	Chemical dosing pot is required for all units.	Closed	Clased.
257	4	Detailed Scope Of Work	4. A. 1		Modify the existing cooling water (for turbine/ generator) supply/ return piping to old radiators and re- route the pipelines to the new equipment.	replace with single cooling water module, A076, RE-ROUTE PIPING, 0, 0, 0	Bidder's understanding is correct.	Closed	Closed.
258	4	Detailed Scope Of Work	4.A.1		The cooling water supply line above ground shall be provided with cold insulation.	What type insulation is requested? Standard GE design is for external protection only, ARE THE SUPPLY AND RETURN LINES TO BE INSULATED AND CLADDED, 0, 0, 0	Insulation shall comply with MARAFIQ guideline specifications MQ-SP-M-4045 and Process Industry Practices Insulation PIP INSH1000 Hot Service Insulation Materials and Installation	Closed	Closed
259	4	Detailed Scope Of Work	4 A 1	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Installation of cooling water pumps under the heat exchanger and piping connections for surge tank and cooling module.	F - 22-37 41 - 43 - 43 - 43 - 43 - 43 - 43 - 43 -	Bidder to comply the requirement as stated in SOW.	Closed	Closed.
260	4	Detailed Scope Of Work	4. A. 1		Tie in the utility connections to the existing ones	0, MARAFIQ TO CLARIFY: WHERE IS TIE IN LOCATION, 0, 0, 0	Refer to the proposal drawings. Tie-in location is shown	Closed	Clased
261	4	Detailed Scope Of Work	4. A. 1	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Tie in drain line to sewer line, as shown in AR10695-PD-A1-005-A sheet 1 & 2.	0, CONFIRM ROUTING OF DRAIN PIPES AND CIVIL WORKS, 0, 0, 0	The requirement is lareday explained duyring site surbvey and probid meeting site visit. Bidder to comply the requirement as stated in SOW.	closed	Clased
265	4	Octaled Scope Of Work	4. A. 1		Painting of piping as per standard & arrow marking of pipe lines.	0. PAINTING STANDARDS, 0, 0, 0	Bidder to follow MARAFIQ guide specifications and standards for palanting standards	Closed	Closed.
269	4	Detailed Scope Of Work	4. A. 1	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Provide all test instrumentation, equipment and accessories necessary for demonstration and putting the equipment into operation before commissioning. All testing equipment shall be calibrated by approved authorities and calibration certificates shall be submitted to Marafig representative for their review and approval.	No instrumentation is required for the testing, please advise if ther is any specific requirement?, 0, 0, 0, 0	Bidder to provide electromagnetic flow meter on cooling water supply line for each skid for each GTG unit.EMF shall be interfaced to MARK Vie. EMF flow meter is required to monitor the performance of the cooling water radiator skid.	Closed	Closed
277	4	Detailed Scope Of Work	4.A.1	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Upon completion of the installation and prior to final acceptance, each equipment/ unit shall be tested to the complete satisfaction of Marafiq. Shall provide all test instrumentation, equipment and accessories necessary for demonstration and putting equipment into operation. Before commissioning, the Contractor shall submit all necessary calculation & performance curves; relay setting and coordination curves to Marafiq for approval.	0, RELAY SETTINGS AND COORDINATION CURVES, 0, 0, 0	Tender / RFP condition Prevails.		Bidder Shall Comply Marafig SOW stated page no.47 clause no.3(b)(2) (Sil Test.) Any Variation on SOW stated / RFP stated Bidder shall submit deviation for specification under RFP deviation for specification under RFP deviation for
204	4	Dermiled Scope Of Work	4.4.1	Colombia de la compansión de la colombia del colombia del colombia de la colombia del colombia del colombia de la colombia del	Operation and test run of each GTG's "Turb ne and/ or Generator Radiator water cooling skid" as one package unit, to ensure that cooling water temperature difference shall maintain at least 5 °C continually for two months (July & August) during peak summer season and having been successfully run under various combinations of GTG loads, ambient temperature and relative humidity. The Cooler that shall capable of providing 100% of the cooling needed at worst scenario. Reduced tube oil temperature and increased unit output. No effect on emission or fire temperature.	0. OPERATION AND TEST RUN TIMING, 0, 0. 0	Eidder to elaborate more what does he want to ask	discussion should	Bidder Shall Comply Marafiq SOW sta page no.48 clause no.3(d) [Site Test] Any Variation on SOW stated / RFP stated Bidder shall submit deviation from specification under RFP deviation form Refer page no. 15 of 15 in Form of Proposal)
386	1	Detailed Scope Of Work	4.A.2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	The scope of work includes but not limited to, engineering, design, procurement & installation of radiator skild cooling modules with necessary piping modification/ tie-in to existing GTG units and installation of supply/return cooling water lines. It includes installation of additional isolation valves, pipeline insulation (for above ground pipes) and pipe supports. Existing Radiators shall be demolished and connecting piping shall be blinded. The Contract shall be executed as an Engineering, Procurement and Construction (EPC) Contract. The replaced new GTG- Radiators shall have satisfactory and trouble free operation with enhanced higher cooling capacities especially during summer season. All work performed shall be in accordance with governing codes, regulation, standards, specifications and Scope of Work (SOW). In case of conflict between SOW and standards / specifications, the content of the SOW will prevail. Installation shall be executed in phases on each GTG's to reduce downtime on the respective GTG, and to have its final acceptance and test run before going to another phase replacement. Contractor shall prepare a risk analysis, work method statement, inspection and test plans for this project for Marafig approval.		The requirement is for colling water radiator skid isolation for maintenanance or annual shut down. All isolation valves requirement shall be based on the fial approval of the P&ID of cooling water radiator skid.	Noted and Closed	Closed
291	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Contractor shall furnish all construction services and construction equipment as required for accomplishing and performing the work, including, but not limited to, all supervision, labor, erection and installation services, haulage, lemporary structures/by pass lines as necessary, consumable materials, tools and equipment.	D. PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Tender/RFP condition prevails.	Noted and Closed	Closed
297	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Supply and provide wye strainers, drains and vents, orifice flanges/ plates, instrument nozzles sampling points and connection points for testing and for charging ethylene glycol water mix	D. CONFIRM IF CHEMICAL DOSING POTS ARE BLOUIRED, D. 0, 0	Chemical dosing pot is required for all units.	These are sample ports and water chemistry ports.	Closed
298	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Supply and provide valves as required or shown in the drawings.	0, WHAT IS THE MEANING OF THEIS STATEMENT, 0, 0, 0	The requirement of valve shall be based on the approval of the cooling water radiator skid P&ID.	Noted	المياه بالج
299	4	Detailed Scope Of Work	4 A 2		Fabrication and installation of piping and pipe supports. Contractor shall be responsible in routing the piping and providing the appropriate support on the floor	0, FS TO CONFIRM INCLUDED IN SCOPE, 0, 0, 0	Bidder to comply the requirement as stated in SOW.	Noted and Closed	Closed. MARAE
300	4	Detailed Scope Of Work	4.A.2		Te-in of new piping to existing lines and header.	0. CONFIRM REQUIREMENT, 0. 0, 0	Tie-in of new piping and header of skid, with existing piping after re-routing of piping as per field condition.	Noted and Closed	Closed PROCUREME





301	A	Detailed Scape Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Supply and Installation of cold insulation and cladding for the supply water line for cooling water module to turbine and generator.	0. CONFIRM INSULATION & CLADDING ONLY REQUIRED ON SUPPLY LINE TO GTG, 0, 0, 0	Bidder's understanding is correct.	Noted and Closed	Closed.
302	4	Detailed Scope Of Work	4. 6. 2		Supply and Installation of make-up water line (process water) for the radiator surge tanks similar to the existing System in GTG -9.	0, CONFIRM TIE IN FOINT, 0, 0 0	Refer the proposal drawings provided with RFP. Tie-in location is already shown to bidder's during recent site visit	Noted	
303	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Supply and Installation of filling facility for the ethylene glycol water mix,(Aqua guard or equivalent recommended by Radiator manufacturer)	D, CONFIRM IF CHEMICAL DOSING POTS ARE REQUIRED, 0, 0, 0	Chemical dosing pot is required for all units.	These are sample ports and water chemistry ports. Noted and Closed	Closed.
304	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Internal and external cleaning of new cooling pipes	0, CONFIRM TYPE OF CLEANING REQUIRED, 0, 0, 0	Bidder's recommended standard cleaning procedure with cleaning equipment is required.	Noted and Closed	Closed
305	4	Detailed Scope Of Work	4. A. 2		To make the Provision for sampling the Cooling water line inlet and outlet Pipe line.	0. CONFIRM LOCATION OF SAMPLING POINTS, 0, 0, 0	Sampling point location will be decided after finalization of P&D.	Per the cooling wate module design. Noted and Clased	Closed.
308	-4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Design, procurement, fabricate & install Cooling water radiator skids module. Each Cooling water module shall consist of Two (3) forced-draft air-cooled heat exchanger, cooling water circulation pump (1 duty+1 Stand by), skid structure, piping, static head/expansion tank, valves, gauges, switches, thermometers and winnu.	GE has a cooling water module design that meets the needs of the Gas Turbine., 0, 0, 0. $^{\circ}$	Bidder shall comply the Tender/RFP requirement.	These options are available. Noted and Closed	Closed.
309	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Each air cooled heat exchanger shall consists of three (3) (2 duty +1Stand by) forced draft fans and shall be capable of cooling 1127 GPM of 30% Ethylene glycol / water mix from 169°F to 142°F while rejecting air at an ambient temperature of 122°F. Normal operation will be to cool the mixture from 186°F to 142°F. Forced-draft air-cooled heat exchanger shall be shipped as a factory-assembled unit complete with fans, motors, and drives.		No. Ridder shall comply the requirement stated in SOW.	Noted	
313	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Shop Hydro lest the entire cooling water module and check the piping fit-up.	Not standard Testing as per GE procedure, if required then it might increase the delivery cycle and cost, 0, 0, 0, 0	Bidder shall comply the requirement stated in SOW.	Noted and Closed	Closed.
315	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Tube bundles shall be purged and pressurized with nitrogen and capped with piping spool pieces, prior to shipment.	Not standard Testing as per GE procedure, if required then it might increase the delivery cycle and cost, 0, 0, 0, 0	Bidder shall comply the requirement stated in SOW.	Closed	Closed.
316	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING	All non-destructive testing shall be in accordance with the requirements of ASME Section VIII, Division 1 (stamped).	Not standard Testing as per GE procedure, if required then it might increase the delivery cycle and cost, 0, 0, 0, 0	Bidder shall comply the requirement stated in SOW.	Noted and Closed	Closed.
320	4	Detailed Scope Of Work	4. A. 2		The cooling water module will have 2 redundant fans per bay and the module shall operate with 4 out of 6 fans in operation (N-2).	This is beyone GE normal supply for cooling fans. How many fans/motors are needed? What is the intent for the redundant fans/motors? . 0. 0. 0. 0.	This requirement is already conveyed to bidders' during site visit. Single cooling whaer skid similar to GTG 9 will eb supplied with three (3) fans and two(2) pumps for each GTG unit.	These options are available. Noted and Closed	Closed
326	•	Detailed Scope Of	1 A 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Tubes: 254 tubes with a staggered triangular tube layout arrangement. Welded carbon steel, 1.0° OO with a thickness of 0.0787°. Fins: The fins will be constructed from aluminum 1060, and wound under tension (L-footed). Header Boxes: The header boxes will be the plug type fabricated from carbon steel and is designed with a corresion allowance of 0.059°. Bundle Frame: Tube supports fabricated from A-36 steel will be boilted to the side frames above and below the finned tube bundle assembly. The spacing of the tube supports will not exceed six feet. To assure maximum sirflow across the finned tubes, heavy gauge galvanized sheet steel uir seal's will be installed both at the sides and ends of the tube bundle assembly. The entire tube bundle	GE design shall be followed (A076), 0, 0, 0	Noted. However bidder shall follow the requirement of API STD 551	Noted and Closed	Cloned
327	4	Detailed Scope Of Work	4-5.2	WATER RADIATOR SKID FOR	framework assembly will be hot dip galvanized after fabrication. The tube bundle assemblies will be mounted on a self-supporting carbon steel structure. The support structure will be hot dip galvanized after fabrication.	GE design shall be followed (A076), 0, 0, 0, 0	Noted. However bidder shall follow the requirement of API STD 661	Noted and Closed	Closed.
335	4	Detailed Scope Of Work	4. A, 2	GTG UNITS 1-B REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-B	All materials to be used in this project shall be approved by Marafiq. The use of a manufacturer's name, model and catalog number is for the purpose of establishing the standard of quality and general configuration desired. Other manufacturers may be submitted for approval by MARAFIQ. Materials incorporated into the systems shall be new and free from defects and imperfections.	0, GE SUPPLIED EQUIPMENT/ DRAWINGS/DOCS/ DESIGN SHALL NOT BE FOR CUSTOMER APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION, 0, 0, 0	Noted. Wherever it is absolutely required approval, Bidder has to submit drawings , documents to MARAFIQ.	Noted and Closed	Ciosed.
340	4	Detailed Scope Of Work	4. A. 2	WATER RADIATOR SKID FOR	Refer to the table in page 53	Painting specs to be reviewed prior to bid submittal, 0, 0, 0	Noted	Noted and Closed	Closed.
342	4	Detailed Scope Of Work	4. A. 2	WATER RADIATOR SKID FOR	Material Stainless steel 304s, 0.38 mm thick x 15.9 wide Set Screw Stainless steel	0. Is this piping cladding, 0, 0, 0	Applicable for all insulation area of this project.	Noted and Closed	Closed
347	-4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	CPT (Size to be specified by contractor)	is this being requested or is MK VI control of the skid acceptable?, 0, 0, 0, 0	MK Vie control of the skid is required per SOW. This CPT is Control Potentail Transformer Size will be decided by the contractor based on the logic for the motor.	Noted and Closed	Closed.
346	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Standard ambient compensated O.L. relay	is this being requested or is MK VI control of the skid acceptable?, 0, 0, 0.0	MK Vie control of the skid is required per SOW.	Noted and Closed	Closed
349	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Indicating lights	is this being requested or is MK VI control of the skid acceptable?, 0, 0, 0, 0	MK Vie control of the skid is required per SOW.	Noted and Closed	Closed
350	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Auxiliary Interlocks	is this being requested or is MK VI control of the skid acceptable?, 0, 0, 0, 0	MK Vie control of the skid is required per SOW.	Noted and Closed	Closed
351	4	Detailed Scope Of Work	4. A. 2		Spring return 3 position selector switch	is this being requested or is MK VI control of the skid acceptable?, 0, 0, 0, 0	These switches are required, for the interlocks and type of switch shall be provided based on the logic.	Noted and Closed	Closed
352	4	Detailed Scope Of Work	4. A. 2		FVNR CB(Size to be specified by contractor) combination starters each with:	is this being requested or is MK VI control of the skid acceptable?, 0, 0, 0, 0	These are the combinations starters required for the motors and the contarctor shall select proper starter based on the system requirement	Noted and Closed	Closed.
353	4	Detailed Scope Of Work	4. A. 2		CPT(Size to be specified by contractor)	is this being requested or is MK VI control of the skid acceptable?, 0, 0; 0; 0	MK Vie control of the skid is required per SOW.	Noted and Closed	Closed
354	4	Detailed Scope Of Work	4. A. 2		Standard ambient compensated O.L. relay	is this being requested or is MK VI control of the skid acceptable?, 0, 0, 0, 0	MK Vie control of the skid is required per SOW.	Noted and Closed	Closed
355	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Indicating lights	is this being requested or is MK VI control of the skid acceptable?, 0, 0, 0, 0	MK Vie control of the skid is required per SOW.	Noted and Closed	Clased.
356	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Auxiliary Interlocks	is this being requested or is MK VI control of the skid acceptable?, 0, 0, 0, 0	MK Vie control of the skid is required per SOW.	Noted and Closed	Closed
357	4	Detailed Scope Of Work	4. A. 2		Spring return 3 position selector switch	is this being requested or is MK VI control of the skid acceptable?. 0, 0, 0. 0	This is required for two Pumps and three fans for each GTG unit for selection of pumps and Fans	Noted and Closed	Closed
361	4	Detailed Scope Of Work	4. A. 2		Shift and deliver safely all the diamantled material from the site to MARAFIQ Yantiu wateriouse.	0. To confirm warehouse focation, 0, 0, 0	Location of ware house, com scrappind, along with clear route map will be conveyed to bidder later on before bid closing date.	Noted and Closed	Closed 3. MARAF
364	4	Detailed Scape Of Work	4. A. 2		Refer to electrical drawings nos. AR10695-EE-A1-001 A & AR10695-E1. A1-007 A non attachment for layout and single line diagram (preliminary only for bidding purposes)	0. Who is responsible to provide the as built single line diagram, 0, 0, 0	Bidder shall be responsible to provide the as built single line diagram.	Noted and Closed	المُرْبِاتُ والنفود . Closed. بالنفود . PROCURE ME



368	4	Detailed Scope Of Work	4 X S	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Each pump of cooling water module shall be provided with dutylstandby selector switch in addition to the Hand/Dff/Auto Switch. In remote mode, manual/automatic option shall be provided and configured for control and operation of each pump in the upgraded GTG Mark-Vie control system, in automatic mode cooling water pump shall be operated automatically by GTG control system based on the logic configured for pump discharge pressure switch. While in manual mode, cooling water pump shall be controlled and operated by operator in the field-Pump (duty+ standby) Start/Stop, run, trp signals shall be interfaced to existing GTG Mark-Vie control system using spare input/output channels for integration to UCS. Refer to the P&ID drawings AR10695-IN-A2-001 for proposal.		The manual selection for lead-lag operation of the pump is required to prove reliability of the skid.	Noted and Closed	Clased.
372	4	Detailed Scope Of Work	4: A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Cooling Water Module shall have Flanged type microprocessor based Electromagnetic Flow meter to monitor and log the cooling water supply flow to radiator. The Contractor shall design, supply install and test electromagnetic flow meter for each cooling water module. Flow meter signal shall be interfaced and integrated to upgraded Mark Vie and ABB UCS. The Electromagnetic Flow meter shall be of carbon steel 150#RF. flanged to ASME B16.5, type having SS tube with Tellon liner and SS316L electrode with remote mount transmitter cum converter. Enclosure of Electromagnetic Flow meter shall be of NEMA 4X.		Yes. This is a specific requirement for each skid to verify the performance of the skid. The reason for specifying the electromagnetic flowmeter is to remolely monitor had log the cooling water flow rate to monitor the degradation in skid performance. The EMF(Electromagnetic Flowmeter) shall be installed in cooling water supply line.	Noted	Clased
373	4	Detailed Scope Of Work	4. A 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Each GTG radiator temperature signals shall be configured in Tenore Servers, Operator Work stations in GTG Local Control Room building #118 and Tenore Servers, Operator Work Stations of GTG cluster in Central Control Building CCB#13, Graphic display pages will be modified, alarms, reports will be configured in existing HMIs in GTG Local Control Room and Central Control Room. Modification, updating of tag database for MIS, reporting system including updating of report server, alarms, reports for remote monitoring, logging and analysis purpose in GTG local Control Room and Central Control Building.		Yes, Bidder's understanding is correct. These are the additional signals (Radiator skid Cooling water supply, return temperature) to monitor the performance of the cooling water radiator skid.	Noted and Closed	Closed.
387	4	Detailed Scope Of Work	4 A 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Dispose construction unsuitable materials and debris.	0, Civil works, where to dispose of debris, 0, 0, 0	Location will be conveyed to bidder before bid closing date.	Noted and Closed	Closed.
390	4	Detailed Scope Of Work	4.A.2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Internal and external surfaces shall be cleaned, primed, and field painted in accordance with the RC specification no. 9900, 9905 & 9906 respectively.	Painting specs to be reviewed prior to bid submittal, 0, 0, 0	Noted.	Noted and Closed	Closed.
391	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Paint all the proposed carbon steel lines including all fittings, valves and pipe supports / hangers as per applicable standards and color codes.	Painting specs to be reviewed prior to bid submittal, 0, 0, 0	Noted.	Noted and Closed	Clased,
392	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Painting works also include any structure affected by this modification works.	0, Painting specs to be reviewed prior to bid submittal, 0, 0, 0	Noted.	Noted and Closed	Closed.
393	4	Detailed Scope Of Work	4. A. 2	REPLACEMENT OF COOLING WATER RADIATOR SKID FOR	All supplied pipes and fittings should be provided with pipe color coding and flow direction.	0. Color coding / Arrow details required, 0, 0, 0	Piping coir coding is still under approval, MARAFIQ will share the same after approval,	Noted and closed	Closed,
408	4	Detailed Scope Of Work	4.8	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG		Liquid fuel specifications for the site. , 0, 0, 0, 0	Bidder to refer the attached fuel specifications.	Noted and Closed	Closed
413	4	Detailed Scope Of Work	4, B, 2	UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Centralized Water Injection Package to control the NOX on the primary Fuel (Sales High Pressure Gus) and Backup Fuel (Light Fuel Oil) as per environmental control RCER to manage emissions and discharges, the RC Requirement less than 80 PPM in Variance of load condition, complete with all required auxiliary and accessory equipment, instrumentation, controls, and utility connections, OM Water Transfer, Storage and Olistribution.	0, 0, Tank location., 0, 0	Tank location is already shown to bidder's during site survey. Tank location is also marked in the proposla drawings also.	Noted and Closed	Closed
414	,	Derated Scope Of Work	4.8.2 httl/wo	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The bidder shall submit along with the alternative proposal for DLN System to control the NOX on the primary Fuel (Sales High Pressure Gas) and Backup Fuel (Light Fuel Oil) as per environmental control RCER to manage emissions and discharges RC requirement less than 80 PPM in variance of Load Conditions, complete with all required auxiliary and accessory equipment, instrumentation, controls; and utility connections. THE SPECIFICATIONS AND DOCUMENTATION HAVE BEEN DEVELOPED FOR THE BOTH OPTIONS; MARAFIQ HAS THE RIGHT TO SELECT THE OPTION. Major elements of the work include: a. Utilization, integration, sharing and, where necessary, expansion of applicable existing facilities, equipment and systems. b. Civil, structural, mechanical, electrical, instrumentation and controls, corrosion control, and all required interface and integration connections to existing site equipment, facilities and utilities, as applicable.	RCER? Need clanfication on this point. , 0, 0, 0, 0	Gas Turbine emission shall comply the RCER (royal Commission Envoronmental Regulations). Royal Commission Is the issuuing authority for permit to Operate the Gas Turbine in compliance with the environmental regulations(RCER-2010)	Noted and Closed	Closed.
418	4	Detailed Scope Of Work	4, B. 2	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The services of a Cathodic Protection and Materials Engineering Specialist shall be used for corrosion control. Corrosion control shall include Cathodic protection as well as material selection and physical barriers such as tanking.	need information on the CATHODIIC Protection system installed at sile. Drawings, and vendor information, 0, 0, 0, 0	Bidder to refer the existing reference drawings of the gas turbine area GTG Building-11 for the cathodic protection drawings.	Noted and closed	Closed
419	4	Detailed Scope Of Work	4. B. 2	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG	and physical damers such as tanking. The services of a geotechnical company shall be used in evaluating soils for foundation designs and field compliance.		t MARAFIO will share the Bidderotechnical soil analysis report with bidders as requested. Soil is not different.	Noted and Closed	Closed
426	4	Detailed Scope Of Work	4. B. 2	UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG	When the design work is finished for a particular facility or installation, the entire set of drawings, including new drawings, shall have the same organization and cohesiveness as before the design	Please clarify this request. , 0, 0, 0, 0	Bidder shall provide the design of Nox control system drawings from the approved vendor only. Entire packaBidder drawings shall bear the one vendor	Noted and Closed	Closed.
432	4	Detailed Scope Of Work	4. B. B (OPTION:1)	UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	work started. The new & unified Royal Commission Environmental Regulations (2010) for Jubali and Yanbu is being implemented by Marafiq and as a general policy of the Management the Regulation is to comply with RC Regulations to control the Nox Emission from the Gas Turbine units. The scope of work is EPC includes detailed engineering design, supply, procurement, installation, testing and commissioning to established satisfactory operation of water injection system for frame 7E GTG units # 1 to 8. Contract shall verify if the system installation is required new tank or can be utilize the existing water tank from STG plant. The Water injection package specification given for the reference only this unit caters for the GTG unit-9. The bidder shall provide the Centralized Water injection package to satisfy the demand of supply to GTG-1-8 simultaneously and this package includes the Storage and Distribution. The Demineralized water input shall be taken from the STG-1-4 & 5-6 Storage and Distribution network. This unit shall locate outside the GTG building. Hence the Space is the constraint. The water injection system shall include but not limited to the following:	GE will provide a water injection skid, 1 per GT: One storage tank can be used as indicated. The size will need to be confirmed to ensure capacity. PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0		1 x Water injection per GT will be provided for control, Noted and Closed	Closed
434	4	Octailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	1. Water injection manifold, associated piping and flex hoses to carry water to the manifold. Ten tubing/flex hose arrangements to carry water to the connection points of each of ten combustion chambers. Ten water flow proportioning valves, one installed in each of the tubing/ flex hose lines supplying each of the combustors. A low point drain is provided on the turbine base adjacent to the inlet connection point. 2. For existing combustors, each with a set of identical water injection nozzles fed from a single connection point per combustor.	Laser scan will be needed for design effort, 0, 0, 0, 0	Bidder shall be respossible to arranBidder for LASRE scanning of the required work.	Noted and Closed	Closed
			4. B. B	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG	Inlet water strainer	Part of water Injection skid, 0, 0, 0, 0	Noted	Noted and Closed	Closed.
457	4	Detailed Scope Of Work	(OPTION-1)						La constant and a con
437		Detailed Scope Of Work Detailed Scope Of Work	(OPTION-1) 4. B. B (OPTION-1)	UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG	Inlet water pressure switch	Part of water injection skid, 0, 0, 0, 0	Noted.	Noted and Closed	Closed.
15.	4	Work	4. B. B	INSTALLATION OF NOX	Inlet water pressure switch High pressure centrifuge water injection pump. Motor assembly with motor space Heater	Part of water injection skid, 0, 0, 0, 0 Part of water injection skid, 0, 0, 0, 0	Noted.	Noted and Closed Noted and Closed	Closed Closed MARAFI

441	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Water pump discharge pressure transmitter	Fart of water injection skid 0, 0, 0, 0	Notes.	Noted and Closed	Crosed.
442	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG	A Five micron (nominal) water filter assembly	Part of water injection skid. 0, 0, 0	Noted.	Noted and Closed	Closed
443	4	Detailed Scope Of Work	4, B, B (OPTION-1)	UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Water filter differential pressure switch	Part of water injection skid, 0, 0, 0, 0	Noted.	Noted and Closed	Closed.
445	4	Detailed Scope Of Work	4, B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The Contractor shall be responsible for complete engineering, design, procure, supply, factory test, delivery to site, installation, site testing, commissioning and documentation of all Control & instrument equipments, field instruments, junction boxes, cables etc. detailed within this scope of work.	is this for water injection or whole plant?. 0, 0, 0, 0	Stated clause is part of the water injection skid. This is applicable to GTG rehabilitation project.	Noted and Closed	Closed.
446	4	Detailed Scope Of Work	4.E B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-9	Environmental conditions for new Demineralized water Storage Tank shall be as per site conditions defined in this scope of work document. Contractor shall design, procure, supply field instruments as per site conditions mentioned in scope of work. Contractor shall consider marine exposure to field instruments while designing selecting material of construction, enclosure material.		This is not acceptable to MARAFIQ. As an EPC contractor, bidder shall be responsible for design, supply install,test and commissioning of DM water storage tank not MARAFIQ.Confirm.	Open, to be discussed	As an EPC contractor, bidder shall be responsible for design, supply, install, to and commissioning of DM water storage tank not MARAFIQ.Confirm. Any Variation on SOW stated / RFP stated Bidder shall submit deviation for specification under RFP deviation form
447		Detailed Scope Of Work	4 B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Purpose of this specification is to define the minimum requirements of design, procure, supply, testing, calibration and supply of field instruments — Level, Pressure, local indicating instruments etc. for new Demineralized water Storage Tank, at MARAFIO, Yanbu. The Contractor shall be fully responsible for the detailed specifications for the works and production of all design documents, drawings necessary to execute the required construction work. SCOPE The scope of work shall include engineering, design, manufacture, testing, calibration and supply of different type of field instruments as per the standard specification. All applicable Codes & Standards adhered to the manufacture & testing applicable for field instruments shall be of the latest version as on the date of issue of enquiry and it shall be the responsibility of contractor. The contractor shall provide necessary instrumentation as required during detailed design of the new Demineralized Water Storage Tank. This should be the minimum level of instrumentation required for the new Demineralized Water Storage Tank shall have a similar to existing Demineralized water tanks. All necessary field instruments which are mandatory to meet or exceed the client's requirements shall be assessed during detail design stage. All supplied field instruments and control systems shall be as per approved MARAFIQ Vendor list. Contractor shall verify that all proposed field instruments shall be as per approved MARAFIQ Vendor list. Contractor shall verify that all proposed field instruments shall be as per approved MARAFIQ Vendor list. Contractor shall verify that all proposed field instruments shall be as per approved MARAFIQ Vendor list. Contractor shall verify that all proposed field instruments to indicate pressure, temperature, liquid levels etc. for maintenance, local monitoring and operation in field.		Noted. Eidder to note that instrumentation and control philosophy shall comply the SOW requirement. However control system and instrumentation shall be linlazed based on the approved P&iD during detail engineering and design.	Noted and closed	Closed
448	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	This specification covers the design, engineering, procurement, supply of materials and equipment as applicable, labor, installation, supervision, inspection, testing and commissioning of the proposed Water Injection System for MYAS MS7001E Gas Turbines, GTG 1-8.			Noted and closed	Closed
450	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The contractor shall furnish all necessary instrumentation and Controls for a complete, functional, and for safe operation of the Water Injection System inclusive of on-base components, controls and off-base water forwarding skild. The work includes interconnecting cables, wires, and conduit, on base and off base, as necessary, for a complete operable water injection system.	customer scope for water forwarding , 0, 0, 0, 0	This is not acceptable to MARAFIQ. As an EPC contractor, bidder shall be responsible for design, supply, install,test and commissioning of water forwarding skid not MARAFIQ.Confirm.	Noted and closed	Closed
452	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The work shall include implementing and configuring/programming water injection control schedule in each GT unit's Mk Vie (new system) control sequence program (CSP) to regulate the system.	will be in MkVie , 0, 0, 0, 0	Noted.	Noted and Closed	Closed
453	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The contractor shall configure the MkVIe GTG 1-8 existing MODBUS with the newly acquired alarm/s, as necessary, in MkVIe Controls and the ABB supplied DCS/UCS. The monitored signal in UCS shall be available in CCB Building 13 GTG / HRSG UCS Tenore cluster and in Building 11B UCS Tenore cluster.	Please clarify MODBUS configuration at the site?, 0, 0, 0, 0	Mark-Vie will exchanBidder the data signals to existing ABB UCS(Symphony Harmony DCS for remote monitoring and data logging) through existing serial Modbus link.	Noted and Closed	Closed.
454	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The contractor shall configure/modify, as applicable, the necessary displays, database in the MkVie HMI and the DCS/UCS GTG Cluster Tenore operator stations. For all Mark Vie modification works GE, OEM, shall be contacted and for all UCS modification works ABB Energy Automation, Italy shall be contacted.	and the second s	Existing GTG (1-8) has not configured for water injection system/DLN and water injection system/DLNis not installed at site. In the proposed project MARAFIO has asked bidder to provide botyh options i.e water injection and DLN. Based on the final decision, bidder has to provide water injection or DLN for existing GTG. Accordingly the contractor shall develop new screen for the offered system.	Noted and Closed	Closed.
456	4	Detailed Scope Of Work	4 E E (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Any equipment affected or damaged during the execution of work by the contractor and not required to be worked on according to the scope of work, shall be restored to its original condition by the contractor, at no cost to the MARAFIQ.	As per Agreed TS&Cs of the contract 0, 0, 0, 0	Tender/RFP condition prevails	equipment under GE control during execution, GE will fix or repair any	Bidder Shall Comply Marafig SOW states page no.64 clause no.3.3.3 (9) & page no.222 clause no.4.1(v). Any Variation or SOW stated / RFP stated Bidder shall submit deviation from specification unde RFP deviation form. (Refer page #15 of 15 under Form of proposal documents)
458	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The work scope includes detailed engineering, design, supply, installation, testing and commissioning of the proposed installation of water injection system including piping, equipments, fittings, on-base & off-base skid complete with its piping system and all required accessories. The scope of Mechanical work of this proposal shall include but not limited to the following	D. PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0 0	Tender/RFP condition prevails	To be agreed	Bidder Reply Not Clear
460	-1-	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG	Contractor shall prepare and submit the required documentations for Marafiq approval such as schedule, engineering, design, drawings, QA/QC plan & safety plan etc.	0, GE SUPPLIED EQUIPMI NT/ DRAWINGS/DOCS/ DESIGN SHALL NOT BE FOR CUSTOMER APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT	Noted. Wherever it is absolutely required approval, Bidder has to submit drawings - documents to MARAFIQ.	Noted and Closed	Closed
461	4	Detailed Scope Of Work	4. B. B (OPTION-1)	UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG	Contractor shall coordinate major equipment and piping layouts/ underground utilities with other trades to avoid obstructions and excessive changes in piping configuration. Excavation & Layout will be done are avoidable underground utilities.	EXCUTION, 0, 0, 0 Some interferences will have to be worked out with Marafiq to meet GE design requirements for equipment function, 0, 0, 0, 0	Noted. This will be decided based on the issued for construction staBidder drawings during the detailed engineering and design staBidder.	Noted and Closed	Closed
469	4	Detailed Scope Of Work	4. B. B (OPTION-1)	UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	be done as per available underground utility. Design, Supply, fabrication & installation of water injection pumps skid mounted with all accessories equipments & fittings inside the GTG building as shown on the reference drawing # 00004-Mt -A 217.	. Water Injection skid will per Gt. design practices and methods 7, 0, 0, 0, 0	Noted: Bidder shall provide documents and design drawinsg for MARAFIQ approval	GE water injection skid will not be submitted for approval. It is per GE design to meet requirements for site Location and routing	



alted Scope Of 4, 8, 8 (OPTION-1	ION-1) CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALL	The drawings and documents shall include submittals of design drawings, shop drawings, as-built drawings, and manufacturer's engineering and other miscellaneous documents, including but not limited to: Instruments layout plans and installation detail drawings Instruments installation details Instruments Specification Sheets Installation and interface wiring diagrams As-Built drawings reflecting all changes based on construction variations. Control system Ladder/Logic diagrams Piping and Instrument diagrams Water Injection Skid Arrangement and Control Panel Drawings Wiring diagram External Interconnection Diagram Instrument List Control System Description Instrument Plan and Location Drawings	Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0	Tender/RFP condition prevails. Noted.	nated and closed GE will supply all drawings to customer for project Alexa and Closed Noted and Closed	Closed. Closed. Closed. Closed.
(OPTION-1 A. B. B. (OPTION-1 A. B. B. B. (OPTION-1 A. B	ION-1) CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALL	The major element of piping works includes but not limited to the following. Any system affected by the modification shall be reconnected including Cathodic Protection. The drawings and documents shall include submittals of design drawings, shop drawings, as-built drawings, and manufacturer's engineering and other miscellaneous documents, including but not limited to: Instruments layout plans and installation detail drawings Instruments installation details Instruments Specification Sheets Installation and interface wiring diagrams As-Built drawings reflecting all changes based on construction variations. Control system Ladder/Logic diagrams Piping and Instrument diagrams Instrument Loop diagrams Water Injection Skid Arrangement and Control Panel Drawings Wiring diagram External Interconnection Diagram Instrument List Control Logic Drawings Control System Description Instrument Plan and Location Drawings	Drawings will be provided as part of conversion package at end of job., PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0.	Including existing cathodic protection. Noted. Tender/RFP condition prevails. Noted.	GE will supply all drawings to customer for project Noted and Closed	Closed
(OPTION-1 A. B. B. (OPTION-1 A. B. B. B. (OPTION-1 A. B	ION-1) CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALL	The drawings and documents shall include submittals of design drawings, shop drawings, as-built drawings, and manufacturer's engineering and other miscellaneous documents, including but not limited to: Instruments layout plans and installation detail drawings Instruments installation details Instruments Specification Sheets Installation and Interface wiring diagrams As-Built drawings reflecting all changes based on construction variations. Control system Ladder/Logic diagrams Piping and Instrument diagrams Water Injection Skid Arrangement and Control Panel Drawings Wiring diagram External Interconnection Diagram Instrument List Control Logic Drawings Control System Description Instrument Plan and Location Drawings	Drawings will be provided as part of conversion package at end of job., PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0. Drawings will be provided as part of conversion package at end of job., 0, 0, 0, 0.	Including existing cathodic protection. Noted. Tender/RFP condition prevails. Noted.	GE will supply all drawings to customer for project Noted and Closed	Closed.
A B B	ION-1) CONTROL SYSTEM FOR GTG UNITS 1-8 B INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	drawings, and manufacturar's engineering and other miscellaneous documents, including but not limited to: Instruments layout plans and instaltation detail drawings Instruments installation details Instruments Specification Sheets Installation and interface wiring diagrams As-Built drawings reflecting all changes based on construction variations. Control system Ladder/Logic diagrams Piping and Instrument diagrams Instrument Loop diagrams Water Injection Skid Arrangement and Control Panel Drawings Wiring diagram External Interconnection Diagram Instrument List Control Logic Drawings Control System Description Instrument Plan and Location Drawings	Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0	Tender/RFP condition prevails. Noted.	drawings to customer for project Noted and Closed	Closed.
A COPTION-1	ION-1) CONTROL SYSTEM FOR GTG UNITS 1-8 B INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Instruments installation details Installation and interface wiring diagrams As-Built drawings reflecting all changes based on construction variations. Control system Ladder/Logic diagrams Piping and Instrument diagrams Instrument Loop diagrams Water Injection Skid Arrangement and Control Panel Drawings Wiring diagram External Interconnection Diagram Instrument List Control Logic Drawings Control System Description Instrument Plan and Location Drawings	Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0	Noted.	Noted and Closed	Closed.
A B B COPTION-1	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Installation and interface wiring diagrams As-Built drawings reflecting all changes based on construction variations. Control system Ladder/Logic diagrams Piping and Instrument diagrams Instrument Loop diagrams Water Injection Skid Arrangement and Control Panel Drawings Wiring diagram External Interconnection Diagram Instrument List Control Logic Drawings Control System Description Instrument Plan and Location Drawings	Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 and Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 and Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 and Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 and Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 and Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 and Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 and Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 and Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 and Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0. Orawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0. Orawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0. Orawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0. Orawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0, 0. Orawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0, 0.	Noted.	Noted and Closed	Closed.
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A B B	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	As-Built drawings reflecting all changes based on construction variations. Control system Ladder/Logic diagrams Piping and Instrument diagrams Instrument Loop diagrams Water Injection Skid Arrangement and Control Panel Drawings Wiring diagram External Interconnection Diagram Instrument List Control Logic Drawings Control System Description Instrument Plan and Location Drawings	Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0 Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0	Noted. Noted. Noted. Noted. Noted. Noted. Noted. Noted.	Noted and Closed	Closed. Closed. Closed. Closed. Closed. Closed. Closed. Closed.
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	ON-1) INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8		Constitution will be an ideal or and all an arrives are the constitution of the consti			
			Drawings will be provided as part of conversion package at end of job 0, 0, 0, 0	Noted.	Noted and Closed	Closed.
alled Scope Of 4. B. B (OPTION-1	ON-1) CONTROL SYSTEM FOR GTG	Instrument Installation Drawings	Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0	Noted.	Noted and Closed	Closed.
ailed Scope Of 4. S. B (OPTION-1	ON-1) CONTROL SYSTEM FOR GTG	Instrumentation grounding plan and details	Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0	Noted	Noted and Closed	Closed.
ailed Scope Of 4. B. B (OPTION-1	ON-1) CONTROL SYSTEM FOR GTG	Instrument Equipment Specification submittals	Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0	Noted:	Noted and Closed	Closed.
alled Scope Of 4, B, B (OPTION-1	ON-1) CONTROL SYSTEM FOR GTG	This shall include all of the equipment specifications required for this contract.	Drawings will be provided as part of conversion package at end of job. , $0,0,0,0$	Noted.	Noted and Closed	Closed
alled Scope Of 4, B, B (OPTION-1	ON-1) CONTROL SYSTEM FOR GTG	Instrument cal bration procedure and loop test procedure.	Drawings will be provided as part of conversion package at end of job. , 0, 0, 0, 0	Noted:	Noted and Closed	Closed
siled Scope Of 4, B, B (OPTION-1		The work scope includes detailed engineering, design, supply, installation, testing and commissioning of the proposed installation of water injection system including civil work, on-base & off-base skid foundation and tank foundation if required etc. complete with its piping support system and all required accessories. The scope of civil work of this proposal shall include but not limited to the following:		Tender/RFP condition prevails	To be agreed	Tender/RFP condition prevails. Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page 15 of 15 under Form of Proposal).
ailed Scope Of 4. B. B (OPTION-1	ON-1) CONTROL SYSTEM FOR GTG	Contractor shall prepare and submit the required documentations for Marafiq approval such as schedule, engineering, design, drawings, OA/QC plan & safety plan etc.	GE designs are per GE design practices and methods. These drawings will be provided at end of job. 0, 0, 0, 0	Noted.	Noted and Closed	Closed.
alled Scope Of 4. B. B (OPTION-1	B INSTALLATION OF NOX	Contractor shall update the existing drawings, O&M Manuals including new equipment catalog information, settings, testing certificate, as-built drawings.	New drawings for medifications and new equiperant will be provided. Existing customer draiwings will not be updated. , 0, 0, 0, 0	Bidder shall be responsible to update, revise existing drawings as required and affected with this rehabiliation project. What is the meaning of the project documentation if system has been rehabilitated and documents, drawinsg are not updated.	New drawings that replace existing drawings will be provided with cross references to existing drawings.	After award of contract Bidder can discuss with documentation departme and finalize the same
aled Scope Of 4. B. B (OPTION-1			0. PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0. 0. 0.	Tender/RFP condition prevails	To be agreed	Tender/RFP condition prevails. Any variation in RFP stated Bidder shall submit Deviation from specifications- under Form of proposal (As per pag- 15 of 15 under Form of Proposal)
	ION-1) CONTROL SYSTEM FOR GTG	It shall be the Contractor's responsibility to locate and protect all underground and exposed structures near the project perimeter.	0. DISCUSS AND AGREE DETAILS WITH MERAFIQ PRIOR TO BID SUBMISSION, 0, 0, 0	Noted (PIL)	Noted and Closed	Closed
giled Scope Of 4. B. B (OPTION-1			DISCUSS AND AGREE DETAILS WITH MERAFIO PRIOR TO HID SUBMISSION, 0, 0, 0	Noted Stranger Strang	Noted and Closed	Closed.
aled:	(OPT) Scope Of 4. B. (OPT) Scope Of 4. B. (OPT) Scope Of 4. B. (OPT)	(OPTION-1) CONTROL SYSTEM FOR GTG UNITS 1-8	(OPTION-1) CONTROL SYSTEM FOR GTG schedule, engineering, design, drawings, QA/QC plan & safety plan etc UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8 Contractor shall update the existing drawings, Q&M Manuals including new equipment cotalog information, settings, testing certificate, as-built drawings. Control system for GTG UNITS 1-8 Civil work shall include but is not limited to excavation, dewatering, backfilling, disposal of excess or unsuitable materials, site grading, compaction, vapour barrier, blinding concrete, concrete foundations, encasements, sleeves, steel supports, and other related fixtures and testing. Scope Of 4. B. B (OPTION-1) CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR	CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALLATION O	(OPTION-1) CONTROL SYSTEM FOR GTG UNITS 1-8 chedule, engineering, design, drawings, OA/OC plan & safety plan etc. OPTION-1) CONTROL SYSTEM FOR GTG UNITS 1-8 INSTALLATION OF NOX The Contractor's responsibility to locate and protect all underground and exposed SubMission, 0, 0, 0 It shall be the Contractor's responsibility to locate and protect all underground and exposed SubMission, 0, 0, 0 INSTALLATION OF NOX The Contractor's responsibility to locate and protect all underground and exposed SubMission, 0, 0, 0 It shall be the Contractor's responsibility to locate any utility which obstructs the execution of the work upon concurrence of Discuss AND AGREE DETAILS WITH MERAFIO PRIOR TO BID Noted INSTALLATION OF NOX The Contractor's shall relocate any utility which obstructs the execution of the work upon concurrence of Discuss AND AGREE DETAILS WITH MERAFIO PRIOR TO BID Noted	CONTROL SYSTEM FOR GTG UNITS 1-8 CONTRO





550	4	Detailed Scope Of Work	4, 5, 6 (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	All site work and equipment installation shall be inspected and tested by the contractor in accordance with Marafiq approved inspection & Test Procedures and witnessed by Marafiq representative. The inspection shall include but not limited to the following. The installation of power cables, conducts. Grounding and bonding of Electrical equipments. Physical check of all electrical equipment and other fasteners to ensure quality of work. Verify the performance of each equipment and feeders. Insulation resistance of electrical equipment. Upon completion of testing, submit certified reports attesting that each test was performed in accordance with approved test procedures.	0 PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0	, Tender/RFP condition preyality	To be agreed	Tender/RFP condition prevails Any variation in RFP stated Bildder shall submit Deviation from specifications under Form of proposal (As per page no 15 of 15 under Form of Proposal).
552	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The required installation of the water injection shall include review the complete design, development, the final as-built drawings and other required documents.	Please clarify what is inlended with this step. 0, 0, 0, 0	This refers to the review of the design and engineering proposed by bidder for NOx control system and its interfacing and compliance, adoptability and compatibility with existing GTG units.	GE water injection skid will not be submitted for approval. It is per GE design to meet requirements for site	Please comply our SOW clause # 3.5(D)(1) page # 72
553	1	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The engineering and design responsibilities, under this contract, shall include obtaining, research, and applying design information on relevant existing systems design documents/drawings by utilizing technical documents from the Owner's files.	Marafiq help on getting needed drawings will be required., 0, 0, 0, 0	MARAFIQ will provide assitance as required by bidders,	Noted and Closed	Closed.
554	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The Nox, test result must be compliance with RC limit at the worst cause	0, TO BE DISCUSSED AND AGREED WITH MARAFIQ PRIOR TO BID SUBMITTAL, 0, 0, 0	Noted:	Noted and Closed	Closed
557	4	Detailed Scope Of Work	4, 5, 8 (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	This specification covers the design, material, construction, testing and performance of the impressed-current type Cathodic Protection systems for the Demineralized Water tank. 1. Cathodic protection system in plant facilities may include but not limited to following structures 1. Exterior surfaces of the storage tank bottom. 2. Reinforced concrete structures 3. Underground metallic structures from corrosion 2. Monitoring and control system of the Cathodic Protection system shall interface with the existing monitoring & control system.	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Tender/RFP condition prevals.	To be agreed	Tender/RFP condition prevails. Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page no 15 of 15 under Form of Proposal).
558	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	1. Cathodic protection system in plant facilities may include but not limited to following structures. 1. Exterior surfaces of the storage tank bottom 2. Reinforced concrete structures 3. Underground metallic structures from corrosion.	0, TO BE DISCUSSED AND AGREED WITH MARAFIQ PRIOR TO BID SUBMITTAL, 0, 0, 0	Noted.	Noted and closed	Closed.
566	4	Detailed Scope Of Work	4. E. E (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Contractor shall be required to make a site visit to perform the following: 1. The soil resistivity measurements 2. The corrosivity estimation 3. A special study of stray current interference	Does Marafig already have this study from original install? Please Clarify request, 0, 0, 0, 0	MARAFIO has Geotechnical study report and same will be shared with bidders. As per RFP bidder shall conduct study as stated requirement in SOW.	Noted, to be reviewed	Tender/RFP condition prevails.Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page of 15 of 15 under Form of Proposal).
567	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	In order to collect data for cathodic protection design calculations and select suitable locations and method for installing anode groundbeds and rectifiers.	Does the Marafig already have this study from original install? Please Clarify request, 0, 0, 0, 0	MARAFIO has Geotechnical study report and same will be shared with bidders. As per RFP - bidder shall conduct study as stated requirement in SOW.	Noted, to be reviewed	Tender/RFP condition prevails. Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page r 15 of 15 under Form of Proposal).
579	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The Site acceptance test shall include but not limited to testing of Water	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Tender/RFP condition prevails	To be agreed	Tender/RFP condition prevails. Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page r 15 of 15 under Form of Proposal).
583	4	Detailed Scope Of Work	4. B. B (OPTION-1)		MARAFIO reserves the right to witness all of testing and inspection activities per approved plan. Test records shall be submitted for the entire system.	Marafig should submit to GE request for special witnessing, and get agreement between Marafig and GE Customer travel would be at customer expense., 0, 0, 0, 0	Bidder shall submit request to MARAFIQ for special witnessing as per RFP requirement. Bidder has to bear all transportation, lodging, boarding charges for MARAFIQ employees and representatives	overall schedule including testing will be provided to Marafiq during excution. Customer travel will be at customer expense.	Please comply our SOW clause # 3.10(1) page # 74
584	4	Detailed Scope Of Work	4. E. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The contractor shall carry out all on-Site inspection and testing of the entire system under the scope of supply. The MARAFIQ shall have the right to reject any part of the work reasonably found unsatisfactory or not acceptable on the basis of results of such inspection and testing.	The rejections shall be agreed between GE and Marafiq as defects, 0, 0, 0, 0	Noted.	Noted and Closed	Closed
288	4	Detailed Scope Of Work	4, B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	It should be noted that the maximum and minimum flow limits and flow cutoff at low fuel flow shall be adjustable to enable compliance with NOx emission requirements and further to prevent excessive invention of water into the combustion chambers of the gas turbine which may cause flame out.	What is Marafiq expected operation profile? Need to understand emissions at low load, 0, 0, 0, 0	Emission of GTG shall be in compliance for load profile from partial load to base load and the fuel flow shall be adjustable for water injection across the range of the turbine for all loads		In final result Bidder shall comply with Nox emmisssion requirements
589	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	For Marafiq configuration where two gas turbine are exhausted one through the exhaust bypass stack and other one through the heat recovery steam generating unit, contractor must to test and measure both the emissions at the bypass stack and the exhaust stack for the heat recovery steam generating unit and the fuel flow to each combustion furbine at same fuel flow and load.	Please clarify? is emissions required to be measured in both stacks? , $0,0,0,0$	Emission of each GTG shall be measured through HRSG stack. HRSG is designed to operate on the exhaust gases of one turbine at atline. Both GTG can not couple exhaust gases to HRSG. Emission shall be measure both GTG in sequence not simultaneously.	Noted and Closed	Closed.
590	4	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The water injection system shall be adopted to work with GE Mark VIe and UCS for the GTG units.	Function/operation of the water injection skid is handled by the Mk VIe controller. The pumps at the DM tank are handled by the BOP controller, 0, 0, 0, 0	Noted. Bidder to note that BOP controller is in bidder's scope not MARAFIQ.	Noted and Closed	Closed.
591	151	Detailed Scope Of Work	4. B. B (OPTION-1)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-II	Contractors is requested to provide the following data: - Uncontrolled no emission factors and the ranges of Nox emissions for gas furbine frame 7001E on both specified fuels (Sales Gas and LFO). - Influence of firing temperature on thermal Nox formation on both fuel (Sales Gas and LFO). - Uncontrolled Nox emission levels and gas turbine manufacturer guaranteed controlled levels using water injection with sales gas and LFO - The contractor shall give at least one (1) week advance notice to MARAFIQ to witness any of the on-site test and inspection activities per approved schedule. - The contractor shall report to and work to the schedule requirements of the contract. and MARAFIQ work times.	Marafiq to provide the Liquid firet specifications for analysis for Nox emissions, 0, 0, 0.	See the attached fuel specifications	Noted and Closed	Closed. Closed. PROCURI MENT

596	4	Detailed Scope Of Work	4. 8. 8 (OPTION-2)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The required professional Replacement shall include review the complete design, development, the final as-built drawings and other required documents necessary and related professional services in connection with the as specified herein, except as may be specifically excluded in the contract document.	Drawings for scope of work will be provided after the excution, 0, 0, 0, 0	This is not acceptable. There is no meaning of review of drawing after execution. Before execution, MARAFIQ shall review and approve the drawings per RFP. Bidder shall comply the requirement. Confirm.	Location, cable and pipe routing drawings outside the GT/GEN are subject to approval.	Bidder shall obtain the approval before start their work at site.
597	4	Detailed Scope Of Work	4. B. B (OPTION-2)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	The engineering and design responsibilities, under this contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/ drawings by utilizing technical documents from the Owner's files.	GE design is based on GE Design practices and methods. Please clarify the intent of the statement in this line., 0, 0, 0.0	Intent is successful bidder shall know the existing gas turbine configuration installed at site for required modification for compatibility and compliance.	Noted and Closed	Closed.
603	4	Detailed Scope Of Work	4. H. H (OPTION-2)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Saudi Arabian Standards Organization (SASO)	GE complies with our GE design practices, ASME B31.3, 0, 0, 0	Noted.	Noted and Closed	Closed.
610	4	Detailed Scope Of Work	4. 8. B (OPTION-2)	INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	Operation and test run of each GTG's with ensure the each Gas Turbine Generators (for GTG 1 to 8) to Improve Heat Rate & Assurance with supporting evidence for the higher reliability achieved through advanced technology.	Please clarify the mechanism of assessing this, 0, 0, 0, 0	This will be assessed in performance testing and monitoring.	Performance testing and Reliability test will be performed per contract	Closed.
635	4	Detailed Scope Of Work	4, G. 3	UPGRADE OF SPEED TRONIC FROM MARK V TO MARK Vie FOR GTG UNITS 1-9	The Contractor shall confirm that all Sit.1, Sit.2, Sit.3 Instrument Protective Functions are independent and provided in separate safety PLC and safety PLC is a certified SIS logic solver per the IEC 61508 series. The system supplied shall comply with IEC6150861611 and is certified by third party such as TUV. GE needs to confirm how they will meet these requirements with new MARK Vie. (Note: Independency - All components used in Sit. 1, 2 and 3 functions SHALL be independent of components used for monitoring and control functions.)	0, 0, 0, Mark Vies Capable Panel can achiev these SIL levels with compliance to IEC 61508.MarkVies is certified by EXIDA.MarkVie can comply IEC 61511 requirements. But complete Loop compliance for IEC61511 is customer scope., 0	IECE1511 for GTG. See attached response. MARAFIQ has to follow safety and security directive to comply with manadatory requirement of HCIS(High Commission of Industrial Security) as per Kingdom Law, Applicable Safety directive is SAF-11. EmerBiddemcy Shutdown system and its compilance is directly referred in this safety directive. MARAFIQ has to legally implement compilance of SAF-11(EmerBiddemcy Shutdown, Isolation and Depressuring). See MARAFIQ guide specifications#MQ-SP-I-7010. PHA and HAZOP Study was never, performed since from the installation of Gas Turbine Biddemerator. MARAFIQ did not have CAUSE and EFFECT diagram developed for the present set up of gas turbine equipment. MARAFIQ has asked bidder specifically to include determination of SIF based on site equipment configuration and company specific risk matrix in compilance with IEC61511 as per SAF-11. MARAFIQ asks Bidder to explain the compelling reasons for not being able to		
680	4	Detailed Scope Of Work	4. C. 3	FROM MARK V TO MARK Vie	Contractor shall provide Turbine Historian either in each HMI's of each GTG 1 to 9 or provide one (1) number suitable GE HISTORIAN SERVER machine with GE Turbine Historian software installed	0, 0, 0, GE Has proposed a Common PI Historian for all GT1-9 Units., 0	Noted. Proposed common Pi historian for GTG1-9 is acceptable.		
701	4	Detailed Scope Of Work	4. C. 3	FOR GTG UNITS 1-9 UPGRADE OF SPEED TRONIC FROM MARK V TO MARK Vie	for historian purposes of all CTG's 1 to 9. The replacement of GTG 1 to 9 MARK V retroful replacement shall be the exact replacement to fit the	0, 0, 0, New markVie Cabinet size will be different to those existing 900x900x2300 for simplex and 1350x900x2300 for TMR, 0	Noted.	GE Review in Process	
702	4	Detailed Scope Of Work	4. C. 3	FOR GTG UNITS 1-9 UPGRADE OF SPEED TRONIC FROM MARK V TO MARK VIE FOR GTG UNITS 1-9	Contractor shall, before replacement note all the errors in each GTG 1 to 9 MARK V and in case they exist shall inform maintenance/operation. After the replacement of GTG 1 to 9 MARK V retrofit/replacement in each GTG 1 to 9, contractor shall fully restore each GTG's and hand over the functional GTG 1 to 9 and UCS system to the satisfaction of MARAFIQ 08M.	0, 0, 0, Any Field instrumentation errors or mechnical issues not that are not part of the scope of work will be excluded, 0	Noted.		
705	4	Detailed Scope OF Work	4. C. 3	UPGRADE OF SPEED TRONIC FROM MARK V TO MARK VIE FOR GTG UNITS 1-9	Contractor shall warranty the GTG 1 to 9 MARK V replacement with state-of-art MARK Vie or latest revision under the scope of supply for one (1) year after initial acceptance. All Technical Bulletins related to GTG 1 to 9 MARK Vie shall be provided with clear written instruction for MARAFIQ consideration during the period of warranty and after at no cost to MARAFIQ.	0, 0, 0, GE standard warranty 18 months from Delivery or 1 Year from Initial Acceptance., 0	Noted.		
711	4	Detailed Scope Of Work	4. C. 3	UPGRADE OF SPEED TRONIC FROM MARK V TO MARK Vie FOR GTG UNITS 1-9	The Contractor shall study the SOE (sequence of events) configuration of GTG 1-8 and GTG-9. SOE configuration in GTG-18 and GTG-9 needs to be studied for all associated electrical protection signals trips and such shall be provided in new upgraded Mark Via. All additional input/Outputs hardware. Terminal Blocks, Modules, Interposing Relays and wiring shall be provided for all associated electrical protection signals causing the trips. Accordingly UCS SOE shall be modified by ABB to meet the Mark Via upgrade. The Contractor shall provide the detailed technical description along with BOM for SOE upgrade of Mark V to Mark Via in their bid document.		PHA and HAZOP Study was never performed since from the installation of Gas Turbine Biddermerator, MARAFIQ did not have CAUSE and EFFECT diagram developed for the present set up of gas turbine equipment. However during UCS upgradation, SOE points were configured and developed in Mark-V and UCS. There are no back up documents and basis available for present equipment configuration. All contributing points for SOE which are responsible for causing trip actions must be included for post trip review analysis. All such points (additional input/Outputs hardware, Terminal Blocks, Modules, Interposing Relays and wiring shall be provided for all associated electrical protection signals causing the trips). Accordingly these new SOE points which are being exchanbidderd through serial Modbus to UCS shall also be modified and configured by ABB to reflect all the chanBidders in UCS so there is no discrepancies of SOE generated.		
12	4	Detailed Scope Of Work	4, C, 3	UPGRADE OF SPEED TRONIC FROM MARK V TO MARK Vie FOR GTG UNITS 1-9	The Contractor shall develop detailed cause and effect matrix based on the trip logic for GTG 1-8. Contributive trip signals shall be provided in GTG 1 to 9 SOE in Mark Vie and SOE report shall be comprehensive in providing the actual cause of the trip for following but not limited to.	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Tender/RFP condition prevails.		
725	4	Oetailed Scope Of Work	4, C, 3	UPGRADE OF SPEED TRONIC FROM MARK V TO MARK Vie FOR GTG UNITS 1-9	The Contractor shall study IPF (instrument Protective Function) for retrofitting of proposed Mark Vie control system in compliance with Standards IEC61508 and IEC61511 for existing GE Frame 7E and 7EA gas turbine. Actual SIFs for critical protection loops including SIL assessment for existing Gas Turbine Generators shall be determined by the contractor based on the site equipment configuration and accordingly all retrofitting work shall be performed to meet the requirements of IEC61508 and IEC61511.	provided for SIL Capability. But SIFs determennation Hazop Study, SIL assesment	PHA and HAZOP Study was never performed since from the installation of Gas Turbine Biddemerator. MARAFIQ did not have CAUSE and EFFECT diagram developed for the present set up of gas turbine equipment. Bidder has to conduct HAZOP STUDY, SIF determination. SIL assessment and making SIL Loop in compliance with IEC61511 as per RFP. HAZOP Study shall be conducted based on company risk matrix. This is the mandatory requirement. Exclusion of HAZOP study, SIF determination, SIL assessment and making SIL Loop in compliance with IEC 61511 is not acceptable to MARAFIQ. Bidder can hire/approach sub-contractor or specialist to conduct HAZOP STUDY and carry out SIF determination, SIL assessment and making SIL Loop in compliance with IEC 61511 for the proposed project. MARAFIQ asks Bidder to explain the compelling reasons for not being able to provide HAZOP and SIL assessment as scoped and thereby compliance to IECC1511.		
750	4	Detailed Scope Of Work	4. C. 3	UPGRADE OF SPEED TRONIC FROM MARK V TO MARK Vie FOR GTG UNITS 1-9	Before commencing the work contractor shall submit Shop Drawings on standard A1 or A3 size indicating details of design, plans and dimensions. All shop drawings shall be in MICROSTATION format. Contractor shall coordinate with Marafig Documentation Center for all documentation requirements.	0. 0, 0, Microstation A3 or A4 drawings will be provided . 0	Noted, However note that required drawing size shall be minimum of A3.		
763	4.	Detailed Scope Of Work	4. C. 3	UPGRADE OF SPEED TRONIC FROM MARK V TO MARK Vie FOR GTG UNITS 1-9	MARAFIO reserves the right to witness all of testing and inspection activities per approved plan. Test records shall be submitted for the entire system.	 0, 0, 0, Customer witnessed tests proposed for 2 panels only All other Panels will be tested as per internal test procedures only. 0 	Noted. Customer witenessed test shall include one test for the MarkVie simplex control system GTG1-8 and second test for TMR of GTG-9.		
800	4	Detailed Scope Of Work	4. O. 2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – B EXCEPT GTG NO.3		0. 0. Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Closed
801	4	Detailed Scope Of Work	4. D. 2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – B EXCEPT GTG NO.3		0, 0, Rotor will be replaced, no need for re-blading , 0, 0	Noted	Noted and Closed	Closed
602	4	Detailed Scope Of Work	4. D. 2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0, Rotor will be replaced, no need fur re-blading , 0, 0	Noted.	Noted and Closed	Closed.
803	4	Detailed Scope Of Work	4, D. 2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0, Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Closed. الم المتود الم

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604	4	Detailed Scope Of Work	4. D. 2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF		0, 0, Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Clased
805	4	Detailed Scope Of Work	4. D 2	GTG 1 – 8 EXCEPT GTG NO.3 REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0, Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Closed
806	4	Detailed Scope Of Work	4. D. 2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0. Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Closed.
807	4	Detailed Scope Of Work	4. D. Z	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0. Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Closed.
808	4	Detailed Scope Of Work	4. D. 2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0, Rotor will be replaced, no need for re-blading , 0, 0	Noted	Noted and Closed	Closed
809	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0, Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Clased
810	4	Detailed Scope Of Work	4.0.2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0, Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Closed.
811	4	Detailed Scope Of Work	4. 0. 2.	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0, Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Closed.
812	4	Detailed Scope Of Work	4, D. 2	REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3		0, 0, Rotor will be replaced, no need for re-blading , 0, 0	Noted.	Noted and Closed	Closed.
831	4	Detailed Scope Of	4. E. 2	EXTENDOR PARTS OF GTG #1-8		0, 0, Our scope is only install or also supply?, 0, 0	Noted.	Noted and Closed	Closed:
883	4	Detailed ≲cope Of Work	4. E. 2	EXTENDOR PARTS OF GTG # 1-8	Operation and test run of each GTG's Extendor parts in Combustion system modification as one package, to ensure the Following Expected Combustion inspection intervals can be extended by reducing wear a Combustion system components and increasing unit availability. Combustion inspection intervals fired hour limits Water 7001E 24K CI Extendor System 12000 And the bidder shall take dismantled Part from modification of the Extendor and Available Capital	Where is the Marafiq Warehouse located, PEP means GE will take the parts and no modification?, 0, 0	MARAFIQ's ware house is located inside PD &SC complex near to the Gas. Turbine GTG site, approximately couple of 100 meters away from GTG site.		
871	4	Detailed Scope Of Work	4. F. 2	FULL UNIT UP RATES of GTG # 1 -8, EXCEPT	Spares from Marafiq Ware house in the Parts Exchange Programme. Shrouded Stator Blades (Stage 17 & EGV)	0, 0. What about other stages of stator blades? Are we goin to replace?, 0, 0	Other stages of stator blades shall also be replaced.	GE offeing all new stator and shrouded	Closed.
1008	4	Detailed Scope Of	4. G. 1	GTG NO. 3 REWINDING OF GENERATORS	Exciter Construction Details.	0, 0. Not received, 0, 0	This had been attached with SoW. However sending again.	stators. Closed	Closed.
1010	4	Work Detailed Scope Of	4. G. 1	FOR GTG UNITS 1-7 REWINDING OF GENERATORS	Generator Construction Details	D, D. Not received, D, D	This had been attached with SoW. However sending again.	Closed	Closed.
1011	4	Work Detailed Scope Of	4. G. 1	FOR GTG UNITS 1-7 REWINDING OF GENERATORS	Outline GA Dwg. For Generator.	D, D, Not received, D, D	This had been attached with SeW. However sending again.	Closed	Closed,
		Work		FOR GTG UNITS 1-7					1 A P
1012	4	Detailed Scope Of Work	4. G. 1	REWINDING OF GENERATORS FOR GTG UNITS 1-7	Rotor Details	0, 0, Not received, 0, 0	This had been attached with SoW. However sending again.	Closed	Closed.
1048	4	Detailed Scope Of Work	4. G. 1	REWINDING OF GENERATORS FOR GTG UNITS 1-7	The Contractor shall provide OSM training (for 4 persons) for MARAFIQ engineers / technicians ahead of Executing the Project.	0, 0, GE to share trainings and MFQ to choose, 0, 0	Bidder's response is not clear. Is there any deviation by Bidder to this requirement by MARAFIO?	is this different than what is listed in Section 4.U?	Tender/RFP condition prevails. Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page n 15 of 15 under Form of Proposal).
1090		Detailed Scope Of Work	11. Hand	REPLACEMENT OF AC/DC POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-8	The work to be performed under this contract consists of furnishing; labor, supervision, tools, equipment, technical and professional services, materials supplies and all articles necessary to perform work involved in replacement of existing, low voltage underground aux power and control cables between the various auxiliary compartments and machines for all GTG-1 to 8 units at Power & Water Complex facilities of MARAFIQ Yanbu The program requirements of this project shall include the "replacement of the existing defective underground cables, rehabilitation of damaged duct banks or the option of installation of above ground with new cables & conduits, as appropriate, as well as renovating the existing duct banks. These cables are low voltage auxiliary Power and Control connections between the Gas Turbines Units and their controls and aux compartments for GTG units No's 1-8. The scope of work for replacement of the underground cables & conduits, rehabilitation of the ductants includes and or above ground installations of cables and conduits includes but not limited to the followings: 1) The Hot Zones near Gas Turbine Machines (Appendix-2.1 to 2.8) 2) MCC to Radiator Skid Power & Control (Appendix-2.9) 3) Gas Control Valve to Mark V from JB-30 4) JB 19 Cables from field, per Cable Schedules 5) Radiator level Switch Cable — 25 Meters for each unit 7) JB1 to Gauge Panel (Pressure Switch) — 25 Meters for each unit 7) JB1 to CC Compartment Cables —— 20 Meters for each unit 7) JB1 to CC Compartment Cables —— 20 Meters for each unit 7) JB1 to CC Compartment Cables —— 20 Meters for each unit 7) JB1 to CC Compartment Cables —— 25 Meters for each unit 7) JB1 to CC Compartment Cables —— 25 Meters for each unit 7) JB1 to CC Compartment Cables —— 20 Meters for each unit 7) JB1 to CC compartment Cables —— 20 Meters for each unit 7) JB1 to CG compartment Cables —— 20 Meters for each unit 7) JB1 to CG compartment Cables —— 20 Meters for each unit 7) JB1 to CG compartment Cables —— 20 Meters for each unit 7) JB		The main requirements have been listed in SoW in sufficient details. However the phrase 'Not Limited To' cannot be removed, because the scope of supply of Contractor also includes the provision of all the services and materials required for accomplishment of the specified works. The scope includes all the material items, accessories, hardware etc. and also any specialist skilled professional services that may be required for the successful installation, testing and commissioning of each equipment/system covered under the SoW.	Noted	MARAFIO MARAFI
	100		1019 700	1	The rest of power and control AC / DC interconnecting cables and conduits, duct banks //renches / manholes, between the various controls, auxiliaries, inter compartments and the machines shall also be field verified by the contractor.				CONTRACTS DEPT.

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1098		Detailed Scope Of Work	4 H.1	REPLACEMENT OF ACIDO POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-B	The contractor shall provide materials and equipment that are new, of the type and qualify specified. Materials and equipment shall be manufacturers' standard products in compliance with refereced standards and adequately described by published product information. Products to be used in hazardous classified areas shall be rated for the specific classification of each area. All kinds of the equipment and materials to be used on this project are subject to the Maraliq approval before delivery at site and inspected at site prior to the installation. The specs of major materials required for this project includes but not limited to the followings:	U. PLEASE LIST ALL FREQUIREMENT AND REMOVE BUT NOT UMITED TO 0, 0	release refer to our reply so from # 1050.	Noted	
1131	4	Detailed Scope Of Work	4. H. 1	REPLACEMENT OF AC/DC POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-8	Upon completion of work and clearing the site from all debris, the contractor may give notice for inspection to the MARAFIO for initial acceptance of the work. If such inspection confirms that the work is completed in accordance the contract and shall have satisfactorily passed functional test. MARAFIO may issue a certificate of initial Acceptance. And the warranty penod will start from the date of initial Acceptance of the work shall be conditioned upon but not limited to the followings:	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Please refer to our reply to him # 1090.	To be agreed	
1165	.4	Detailed Scope Of Work	4.11		Following are the components of exhaust gas system removal & installation. The contractor will remove & install the exhaust system but not limited to the following	0, PLEASE LIST ALL PEQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0, 0	Please refer to our reply to item # 1090	requirement includes Exhaust plenum, exhaust ducting and silencers, expansion joints, and simple	Tender/RFP condition prevalls.Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page n 15 of 15 under Form of Proposal). As per SOW stated up to exhaust plent to be replaced. Ehaust stack not covere in SOW.
1179		Detailed ≅cope Of — Work	4.1.1		Silencer casing is made of Carbon steel S23SJR or Equivalent with stiffening profiles according to structural requirements. The internal insulation and silencer baffles infill is wrapped with one layer fiberglass cloth, one layer fiberglass mat and one layer of Stainless steel screen. The solid and perforated lining is manufactured from 1.4512, type 409 stainless steel sheets, liner sheet thickness is 0.12°, and insulation thickness is 3°. Silencer baffles manufactured from 1.4512, type 409. Coating Ductwork, external surfaces and stack support Sanoblasted. SA 2.5 Primer 75micro.m Zinc primer Top cost to be applied at site Duct work internal surfaces Not Sandblasted, not painted (Primer will be applied up to first row of insulation study at the erection joint areas)	What are the site sound requirements?, CONFIRM REQUIREEMENT, 0, 0, 0	Please refer to our reply to hem # 10'40.	Noted.	
1180	4	Detailed Scope Of Work	4, 1, 1	REPLACEMENT OF EXHAUST PLENUM FOR GTG UNITS 1-8	After installation measure the skin temperature of Duct & acoustic performance.	Is GE required to replace the ducting?, 0, 0, 0, 0	Please refer to our reply to liem d 1090	Exhaust plenum, exhaust ducting and silencers, expansion joints, and simplet cycle exhaust stack replacement.	Tender/RFP condition prevails. Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page no 15 of 15 under Form of Proposal) (As per page no 15 of 15 under Form of Proposal). As per SOW stated up to exhaust plenut to be replaced. Ehaust stack not covered
1181	4	Detailed Scope Of Work	4. J	REPLACEMENT OF SHUT OFF & BYPASS DAMPER GEARED MOTOR FOR GTG UNITS 1-4		ts this replace in kind equipment? _ 0, 0, 0, 0	Please refer to our reply to item # 1090.	GE offenng replacement divertor	render/RFP condition prevails. Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page in 15 of 15 under Form of Proposal)
1183	4	Detailed Scope Of Work	4, J, 1	BYPASS DAMPER GEARED	Following are the components of exhaust gas system removal & installation. The contractor will remove & install the new Shut off Geared motor and By pass damper motor with gear box but not limited to the following.	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0.	Please refer to our reply to item ∉ 1090.	GE offering replacement divertor damper motor and gear box, please confirm this is required	Tender/RFP condition prevails Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page no 15 of 15 under Form of Proposal)
1198	4	Detailed Scope Of Work	4. K. 1		Contractor shall notify MARAFIQ upon the completion of the work including satisfactory completion of the tests required as per the technical specifications. Such notice shall be in writing and shall be deemed to be a request by Contractor for MARAFIQ to issue an initial Acceptance Certificate. MARAFIQ will, following delivery of such notice, conduct inspection of the completed work and either issue to Contractor the Initial Acceptance Certificate indicating the date on which the work for which an Initial Acceptance Certificate is issued were completed, or notify the Contractor of the unfinished portion of the work or specify the deficiencies which are discovered and are required to be completed by Contractor within a mutually agreed time limit before the issuance of such certificate. Upon completion of specified unfinished portion of the work or correction of the specified deficiencies, Contractor shall so notify MARAFIQ in writing and MARAFIQ either to issue an Initial Acceptance Certificate or give Contractor notice of failure to complete the specified unfinished portion of the work or correct the specified deficiencies. Initial Acceptance of the Work shall be conditioned upon but not limited to the following:		Please refer to our reply to Item # 1030.	open*	THE CHILD IN . 3 YEL
1208	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 788		0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0.	Please refer to our reply to Item # 1090.	open	F.O. 19121 (1911)
1223	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 788		0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Please refer to our reply to Item # 1090.	open	
1258	4	Detailed Scope Of Work	4 K 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 768		9, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Please refer to our reply to Item # 1090.	open	
1366	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	/ The Contractor to provide Metal Clad Switchgear and all related materials and equipment that are new, of the type and quality specified, Materials and equipment shall be manufacturer's standards products in compliance with referenced standards and adequately described by published product information, it includes but not limited to the following.	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Please refer to our reply to Item # 1090.	ореп	J. MARAFIQ
1383	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	Preparation of design and shop drawings: The design shall follow the existing system philosophy unless specified otherwise. This includes but not limited to the following:	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Please refer to our reply to Item # 1090.	open	PROCUREMENT &

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1406	4	Detailed Scope Of Work	4. L. 1	REFLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1.2.4,7 & 8	Preparation of design and shop drawings The design shall follow the existing system philosophy unless specified otherwise. This includes but not limited to the following.	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0: 0.	Please refer to our reply to Item # 1080:	open	
546	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	The installation of Metal Clad Switchgears shall be in accordance with Manufacturer's recommended procedure and applicable standards subject to MARAFIQ approval. The installation works for the Metal Clad Switchgears shall include but not limited to the following:	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0		open	
601	4	Detailed Scope Of Work	4. M. 1		Two 3-phase earth switches shall also be installed in each breaker cubicle (a) one earth switch, for grounding the Generator incoming feeder (to be located on generator side of the breaker). (b) Another earth switch for grounding the outgoing feeder to Generator Transformer (to be located at the downstream side of the Disconnecting switch on the Generator Transformer side of the breaker) Each earth switch shall have two positions, Open and close. The switches shall remain in open position during normal operation when GTG breaker is closed. All the required permissive interlocks shall be provided to prevent operation of the earth switch on energized (five' condition). Such interlocks shall include, but not limited to the following:		Please refer to our reply to liem # 1090	open	
624	4	Detailed Scope Of Work	4, M, 1		The Gas Turbine Generator (GTG) CBs are very critical to power generation system. The GTG CB connects the generator to step up transformer for power transmission. If any one of the GTG CBs falls, then corresponding Generator will be Isolated resulting in loss of power and severe impact on Generation system. Hence it is decided to replace ABCBs with SF6 insulated CB for increased reliability. The Contractor shall carry out the work on turnkey basis including engineering, manufacturing of the equipment, field installation in existing MV switchgear, interface of the new equipment with existing plant equipment, testing and final commissioning. For successful completion of retrofitting of existing GTG ABCB with SF6 gas insulated CB, the Contractor shall conduct site survey and gather all information related to existing ABCB. The Contractor is responsible for complete engineering and design activities including calculations, studies, drawings, inspection & test plans, and other submittal requirements specified elsewhere in this contract. The Contractor shall, as a part of his responsibility, check the ratings and sizes of those components whose rating and sizes are specified in the contract document, The Contractor's scope of work shall include following as a minimum but not limited to:		Please refer to our reply to Item # 1090.	open	
535	4	Detailed Scope Of Work	4. M. 1		Installation of new CB Cubicle housing SF6 insulated, 15 kV, 4000A, 3P, 60 Hz Circuit Breakers, complete with all associated accessories and interlocks as specified in but not limited to Drawing No. 006R-P75-006 for satisfactory operation of the CB and all associated equipment. The Contractor shall also provide additional interlocks as required for the control scheme. The new CBs shall be interfaced / integrated with existing system for all controls, protection as well as indications and alarms associated with Unified Control System (UCS) in Central Control Building No, 13.	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Please refer to our reply to Item # 1090.	open	
40	4	Detailed Scope Of Work	4. M. 1	REPLACEMENT GENERATOR BREAKER OF GTG UNITS 1, 2, 3,	The CB shall be provided with, but not limited to the following accessories.	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Pleaso refer to our reply to Item # 1090.	open	
151	4	Detailed Scope Of Work	4. N. 1	4, 7 & 8 REPLACEMENT OF HYDROGEN CONTROL PANEL FOR GTG UNITS 3-8	The contractor's work shall include but not limited to the following:	D, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Please refer to our reply to Item # 1000.	open	
861	4	Detailed Scope Of Work	4, N. 1		Provide all on-site startup/commissioning services. The startup services shall include but not limited to the following: 1) Check and verify all I/O connections. 2) Apply power to the new panets / system. 3) Adjust, calibrate, and configure all field installed instrument / transmitters/equipment.	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Please refer to our reply to Item # 1090.	open	
934	4	Detailed Scope Of Work	4. N. T	REPLACEMENT OF HYDROGEN CONTROL PANEL FOR GTG UNITS 3-8	Contractors shall be responsible for making the physical connection of all Piping, Tubing, Cable Connections, Electrical Power System and MARAFIQ DCS associated with Existing System. The contractor shall develop the details of interface requirements and verify the connectivity of the existing system and information furnished. The contractor shall notify MARAFIQ of all and any required corrections. The contractor shall be responsible for making the physical connection at all the following interface of the existing system, unless otherwise indicated, the interface shall include, but not limited to the following services.	0. PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Please refer to our reply to Item # 1030	open	
955	4	Detailed Scope Of Work	4. Q. 1		The objective of this project is to upgrade the existing Excitation System including Automatic Voltage Regulation (AVR) by replacing obsolete ones, with the latest Digital type Excitation System & Automatic Voltage Regulators (D-AVR) for Gas Turbine Generators (GTGs) No. 1, 2, 3, 5, 7 and 8 Of MARAFIO at Yanbu.		Need to discussed with Bidder's about the obsolence of EX2000. Bidder's proposed solution is not acceptable to MARAFIO since existing EX2000 can still communicate to Mark Vie using ARCNET to ETHERNET gateway/protocol converter. This information is already provided in * Mark* Vie Control Migration from Mark V Control* So there is no need to upgrade existing EX2000 system of GTG-9. Bidder shall note that there is ARCNET to ETHERNET gateway available with Bidder for provision of communication of Ex2000 to upgraded MarkVie.	GE Review In Process	
258	4	Detailed Scope Of Work	4. O. 1		The Bidders are required to prepare and submit their bids for replacement of existing obsolete Excitation System including AVRs with the latest product of Excitation System & Automatic Voltage Regulator (AVR), for Six (6) of Gas Turbine Generators (GTGs) No. 1, 2, 3, 5, 7 and ft of MARAFIQ at Yanbu. It is the sole discretion of MARAFIQ to release any of the unit (s) for implementation of the work under this Contract. Plant operation however, shall always be given priority over the contract work.	to Mark Vie, EX2000 needs to also be upgraded to EX2100e so to be able to	can still communicate to Mark Vie using ARCNET to ETHERNET	GE Review In Process	
965		Detailed Scope Of Work	1-111/1-2 1-111/1-2 1-111/1-2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	The Contractor shall conduct feasibility study and suggest suitable latest state of art digital excitation system for existing GTG sets after carefully studying the present arrangement of the excitation system. This feasibility study shall be presented to MARAFIQ representative for their review and approval.	n 0, 0, 0, Existing AVRs for units 1 to the are very old multi-sectional (combination of rotating and stationary AVRs). This is system is very old and due to many components, very slow in generator terminal fluctuations. GE's recommendation is to replace all the existing AVRs with static excitation systems. Static exciters, each comes with its own PFT connected to 4 to0 Unit Auxiliary Transformer (UAT) and static excitation system connected directly to the Generator's main field via the existing brushes. This is provided that UAT size is considered for the power needed by the exciters, because wo're replacing rotating exciter with static, the space required for static excitation is needed. Exact dimensions will be given in GE proposal., 0	study The Contractor shall conduct feasibility study and suggest suitable latest state of art digital excitation system for existing GTG sets after carefully studying the present arrangement of the excitation system. This feasibility study shull be presented to MARAFIQ representative for their review and approval.* Hence it is Contractor's responsibility to determine the feasibility of installing a new system after a comprehensive study of existing arrangement to ensure compatibility of the new system with existing interconnections and interfacing	GE Review in Process	y Mak
1974	-4	Detailed Scope Of Work	4. O. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Before commencing the work, submit Shop Drawings on standard A1 size indicating details and dire	R. O. O. All supplied documents and their formuts like drawings, manuals, hist reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Muralle for review only if comments from cultioner can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply. 28	securations. Please see above reply	GE Review in Process	PROCURI SCONIHAC



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la(p	4	Detailed Scope Of Work	4.0.2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	The Drawings and documents shall include Digital type Expitation System & D-AVR specification diag	Q. O. Q. All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafig for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply. 10	Please see above reply.	GE Review in Process
1976	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1. 2 3, 5, 7 & 8	and the second s	0, 0, 0, All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafig for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply. , 0	Please see above reply.	GE Review in Process
1977	4	Detailed Scope Of Work	4, 0.2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	All materials, cables and wires and other misc, items required on this project shall be submitted for a	0, 0, 0, All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply. , 0	Please see above reply	GE Review in Process
978	4	Detailed Scope Of Work	4.0.2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	The Contractor shall submit installation/erection drawings for new equipment and demotition drawing	0. 0, 0, All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply. , 0	Please see above reply	GE Review in Process
979	4	Detailed Scope Of Work	4.0.2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	The Contractor shall submit a detailed method statement for installation and termination of proposed	0. 0. All supplied documents and their formats like drawings: manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply. , 0	Please see above reply	GE Royew n Process
960	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	The Contractor shall submit Operation & Maintenance Manual(s), containing of trouble shooting Instr	0, 0, 0, All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafiq for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply 0	To be discussed during kick off meeting.	GE Review in Process
981	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	The Contractor shall submit commissioning procedures for commissioning.	0, 0, 0, All supplied documents and their formats like drawings, manuals, test reports, etc. from GE will be based on GE standard manufacturing design specific to the supplied equipment from GE. They will be provided to Murafig for review only. If comments from customer can be incorporated, GE will incorporate. Otherwise GE supplied standards will apply. , 0	Please refer SECTION 01720 - RECORD DOCUMENTS of SoW and comply.	GE Review in Process
985	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Within filteen (15) days after the notice of award of the Contract, Contractor shall submit an inspection	0, 0, Schedule will be determined 4 weeks after customer kick off meeting with Project Manager, 0	Please refer 'SECTION 01720 - RECORD DOCUMENTS' for format requirements etc.	GE Review in Process
986	4	Detailed Scope Of Work	4. O. 2		MARAFIQ reserves the right to witness all or part of testing and inspection activities per approved plan, MARAFIQ or its authorized Representative / 3rd party may witness such activities. Test records shall be submitted for the entire system.	0, 0, 0, Test reports and other documents will be provided per GE standard manufacturing process and procedures, 0	Please refer SECTION 01720 - RECORD DOCUMENTS of SoW and comply.	GE Review In Process
192	4	Detailed Scope Of Work	4. 0. 2		The Contractor shall submit RSPL of each piece of equipment followed by the technical approval of the Preliminary Equipment list (PEL) by MARAFIQ. The Contractor shall promptly update the submittal and proceed in line with procedure.	0, 0, 0, All documents will be based on GE manufacturing standards., 0	Please refer SECTION 01720 - RECORD DOCUMENTS of SoW and comply.	GE Review in Process
000	4	Detailed Scope Of Work	4.0.2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Visual inspection of completed work shall be performed after application.	0, 0, 0, All tests will be based on GE Standard tests applied to such exciters., 0	Please refer to the applicable testing standards specified in Section IV O, under i Technical Requirements* - '3. Applicable Codes and Standards', and comply with the requirements. Any deviation from applicable International Standards should be brought out for MARAFIQ's review and approval.	-GE Review in Process
2001	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	insulation resistance test shall be performed on all electrical and control components and cables.	0, 0, 0, All tests will be based on GE Standard tests applied to such exciters., 0	Please refer to the applicable testing standards specified in Section IV O under to Technical Requirements* - ' 3. Applicable Codes and Standards', and comply with the requirements. Any deviation from applicable international Standards should be brought out for MARAFIO's review and approval.	GE Review in Process
002	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Physical checks of all electrical termination and related installation	0, 0, 0, All tests will be based on GE Standard tests applied to such exciters., 0	Please refer to the applicable testing standards specified in Section IV Qunder I Technical Requirements* - 13. Applicable Codes and Standards*, and comply with the requirements. Any deviation from applicable International Standards should be brought out for MARAFIO's review and approval.	- GE Review in Process
:003	4	Detailed Scope Of Work	4.0.2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Megger the insulation and continuity checks of all wiring to ensure proper connections and grounding	0, 0, 0, All tests will be based on GE Standard tests applied to such exciters , 0	Please refer to the applicable testing standards specified in Section IV O, under I "Technical Requirements" - '3. Applicable Codes and Standards', and comply with the requirements. Any deviation from applicable International Standards should be brought out for MARAFIQ's review and approval.	-GE Review in Process
0006	4	Octalled Scope Of Work	4,0,2		The Contractor shall be responsible for providing necessary Training to the MARAFIQ Operation & Maintenance personnel, in order to operate and maintain the system installed under this project. Excitation training including the AVR shall be provided to 5 MARAFIQ technical staff and shall be arranged at vendors training site. It shall include minimum trouble shooting, Online & Offline simulation, adjustments of excitation parameters etc. The training shall be provided for both system operation and maintenance of the equipment. Course materials, training aids and qualified instructor shall be provided by the Contractor. The on-site training shall include but not limited to the following coverage:	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	The phrase 'Not Limited' cannot be removed. The broad requirements of Training are listed, but Contractor shall also include any items not specifically listed, but considered as required to operate and maintain the system.	g GE Review in Process
003	•	Detailed Scope Of Work	4.0.2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8		0, 0, 0, Existing AVRs for units 1 to 8 are very old multi-sectional (combination of rotating and stationary AVRs). This system is very old and due to many components, very slow in generator terminal fluctuations. GE's recommendation is to replace all the existing AVRs with static excitation systems. Static excitation systems. Static excitation systems Static excitation systems that one of the component of the component of the component of the component of the power provided the unit static excitation system connected directly to the Generator's main field via the existing burstes. This is provided the UAT size is considered for the power needed	Please refer to our reply to Item # 1965.	GE Review in Process.
		3 6	1411/00		AVR's and accessories of the generator excitation system from the site Existing Excitation system comprise of Main Exciter, Pilot Exciter, Sticon rectifiers & Automatic Voltage regulator. The details of present excitation system are given in GTG GEN, AVR & Excitation DATA attached with this scope of work.	examp ordanes. This is provided the day 32ct is considered for the power necessibly the exciter with static, the space required for static excitation is needed. Exact dimensions will be given in GE proposal 0		
	-	N 1077	- Chino		The existing Excitation System can be replaced as whole with sophisticate excitation system such as GE EX2100e Excitation System or equivalent to be compatible with existing GTG sets. It may be replaced with an Excitation Transformer of suitable rating or Single exciter with brushiBrushless type exciter to be matched to our existing generator capacity after conducting feasibility study as described in clause 2.2.3 of this scope of work.			
1010	4	Detailed Scope Of Work	4.0.2	DIGITAL EXCITATION SYSTEM	The scope of supply of this Contract includes all engineering, design, and procurement, construction, testing and commissioning necessary for the replacement and satisfactory operation of existing obsolete AVRExcitation system with latest product of state of art Digital Excitation System & AVR's. Includes but not limited to the following.	0. PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0	Tender/RFP condition prevails	GE Review in Process

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2013	4	Detailed Scope Of Work	4.0(2)	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3 5, 7 8 8	The material includes, all necessary modules for a dust redundant Digital type Automatic Voltage Re	$_{\rm I}$ 0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0 0. $_{\rm II}$	Please note that 'REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM' is required only for TG UNITS 1, 2, 3, 5, 7 & 8, and not for Unit 9.	GE Review n	
				FOR GIG UNITS 1,2,3 5,7 8 8			The requirement is for 'dual redundant' Digital type Automatic Voltage Regulators, Any deviation to this requirement will not be acceptable, unless and until there is a valid technical justification. As part of Contractor's engineering responsibility, GE should verify in detail the		
							space requirement for the specified system with respect to space availability at site.		
							Please refer the following clauses also in Section IV - O: 2. 2 The engineering and design responsibilities, under this Contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/ drawings by utilizing technical documents from the		
							Owner's files. 2. 3 The Contractor shall conduct feasibility study and suggest suitable latest state of art digital excitation system for existing GTG sets after carefully studying		
2020	4	Detailed Scope Of	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM	CPU unit	0, 0, 0, Offered exciters by GE will be redundant controls/S implex bridge for units 1 to 8 and redundant controls/redundant bridge for unit 9. Reason for units 1 to 9.	the present arrangement of the excitation system. This feasibility study shall be Please note that "REPLACEMENT OF AVE BY DIGITAL EXCITATION SYSTEM" is required only for TG UNITS 1, 2, 3, 5, 7 8 8, and not for Unit 9.	GE Review n Process	
		The Set Vic		FOR GTG UNITS 1, 2, 3, 5, 7 & 8		having one bridge instead of 2 is because of the limited space available at Marafiq	The requirement is for 'dual redundant' Digital type Automatic VoltaBildder Regulators. Any deviation to this requirement will not be acceptable, unless and until there is a valid technical justification.	rivess	
		100	1411/00-			and that means more space needed. The existing exciter space at Marafig site is very limited. So GE recommendation is to go with Redundant controls, Simplex bridge on exciters so to minimize space requirement. If redundant bridge is absolutely required, GE will provide that but customer would need to make sure	As part of Contractor's engineering responsibility, Bidder should verify in detail the space requirement for the specified system with respect to space availability at site.		
Ĭ		(i)	1100 (04.5)			adequate space is provided for dual bridge system. C) AVR cubicles will be based on GE manufactruing standards. D) Existing PT and CT's will be used. , 0	Please refer the following clauses also in Section IV - O: 2. 2 The engineering and design responsibilities, under this Contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/drawings by utilizing technical documents from the Owner's files. 2. 3 The Contractor shall conduct feasibility study and sugBidderst suitable latest state of art digital excitation system for existing GTG sets after carefully studying the present arrangement of the excitation system. This feasibility study shall be		
							presented to MARAFIQ representative for their review and approval.		
2035	4	Detailed Scope Of Work	4. O, 2	DIGITAL EXCITATION SYSTEM	The system cubicle shall be metal enclosed with accessibility from front and rear, including necessary wiring, terminals, and switches or circuit breakers, Internal power, ground, and control busses, connectors, fuses, terminal blocks, name plates, permissive control switches with indicating lights, shall be included. All internal devices for external connections shall be wired to terminal blocks with block and points suitability labeled. Controls circuits for the various components and functions shall be provided with the fuse disconnect switches.	0, 0, 0, Exciter cubicles will have front access., 0	Accessibility should be from both front and rear.	GE Review in Process	
2062	4	Detailed Scope Of Work	4. D, 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	The power part of Digital Automatic Voltage Regulator with appropriate ratings shall be provided with the following components:	0, 0, 0, GE EX2100e do not come with old type field circuit breakers. GE's EX2100e has its own design with inverting voltage and contactors which are integral part of Exciter design and functionally act as field breaker to discharge energy from Main generator field like a field circuit breaker so it replaces the need for separate field breaker.		GE Review in Process	
2066	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	The non-materials requirements for the enhancement of this stepping automation system—shall incl	u0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, Al items I to xiii will be based GE standard documents and deliverables 0		GE Review In Process	
2067	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	All composite Engineering packages, materials procurement proposals, manufacturing and test procurement	0, 0, 0, All items I to xiii will be based GE standard documents and deliverables., 0		GE Review in Process	
20€8	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Software and Hardware package.	0, 0, 0, All Items I to xill will be based GE standard documents and deliverables0		GE Review in Process	
2069	4	Detailed Scope Of Work	4.0.2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Power and / or control schematic diagrams.	0, 0, 0, All items I to xill will be based GE standard documents and deliverables., 0		GE Review in Process	
2070	4	Detailed Scope Of Work	4, 0, 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 6	Sequence / logic diagrams	0, 0, 0, Alf items I to xiii will be based GE standard documents and deliverables , 0		GE Review in Process	
2071	4	Detailed Scope Of Work	4, 0, 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Winng diagrams.	0, 0, 0, All items I to kill will be based GE standard documents and deliverables., 0		GE Review in Process	
2072	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Specification and Data Sheets.	0, 0, 0, All (tems I to xiii will be based GE standard documents and deliverables , 0		GE Review in Process	
2073	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Complete parts data package.	0, 0, 0, All items i to xiii will be based GE standard documents and deliverables., 0	A STATE OF S	GE Review in Process	
2074	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Installation and erection instructions.	0. 0, 0, All items I to xiii will be based GE standard documents and deliverables . 0		GE Review in Process	
2075	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Certified test reports, certificates, data and curves.	0, 0, 0, All items (to xii will be based GE standard documents and deliverables., 0		GE Review in Process	
2076	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Operating instructions.	0, 0, 0, All items (to xiii will be based GE standard documents and deliverables., 0	Please see above	GE Review in Process	
2077	4	Detailed Scope Of Work	4. 0. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Maintenance manuals / instructions	0. 0, 0, All items I to air will be based GE standard documents and deliverables., 0	Please see above.	GE Review in Process	HARAFIQ"
2078	. 4	Detailed Scope Of Work	4, 0, 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Bill of materials	$0,0,0$ All items I to $x \overline{x} $ will be based GE standard documents and deliverables , 0	Please refer SECTION 01720 - RECORD DOCUMENTS of SeW and comply.	GE Review in Process	PRUCUREMENT & CONTRACTS DEPT



20%	4	Octaled Scope Of Work	4. D. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1: 2, 3, 5, 7 & 8	The entire excitation system including AVR system equipment is subject to undergo for routine shop	t0, 0, 0. Since all units it to 8 are identical, Customer witness Factory Acceptance Test (FAT) for one unit is included in base scope of supply , 0	Please refer to the applicable testing standards specified in Section IV Ojunder II Technical Requirements* - 13. Applicable Codes and Standards*, and comply with the requirements. Any deviation from applicable International Standards should be brought out for MARAFIO's review and approval.	-GE Review in Process	
2097	4	Detailed Scope Of Work	4 D. 2	PEPLACEMENT OF AVA BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	The entire equipment of the system shall go for factory tests including, but not restricted to the following. MARAFIQ shall have the right to witness the shop tests or may examine and review the engineering and test paper work only.	0, 0, 0, Since all units 1 to 8 are identical, Customer witness Factory Acceptance Test (FAT) for one unit is included in base scope of supply. FAT tests will be based on GE standard tests applied to such equipment.	Please refer to our reply to item # 2003	GE Review in Process	
2104	4	Detsied Scope Of Work	4. O. 2	REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8	Post installation all equipment shall go through the extensive testing with appropriate reviews on the Factory Acceptance Tests results as above. These tests shall include but not limited to the following: The Contractor shall carry out the integrity test on the entire existing cables and the required cable replacement shall be done with no additional cost to the MARAFIG.	PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, SAT lests will be based on GE slandard tests applied to such equipment., 0	The phrase 'Not Limited' cannot be removed. The broad requirements of Testing are listed, but Contractor shall also include any tests not specifically listed, but considered as required to ensure the Integrity of the system. Also please refer to our reply to Item # 2003.	GE Review in Process	
2154	4	Detailed Scope Of Work	4, P, 2	INSTALLATION OF HVAC SYSTEM & HYDROGEN DETECTOR INSIDE DC COMPARTMENT FOR GTG UNITS L-8		0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0, 0	Tender/RFP condition prevails.	To be agreed	Tender/RFP condition prevails. Any variation in RFP stated Bidder shall submit Deviation from specifications under Form of proposal (As per page no 15 of 15 under Form of Proposal)
2354	4	Detailed Scope Of Work	4. R. 1	METER & OTHER FIELD	Description of existing flow meter system: Onfice based flow metering system has been designed and installed separately for each GTG. The existing sales gas flow meter of each GTG is designed using multi variable type flow transmitter model 3095 of EMERSON make, which has been discontinued and become obsolete. The multi variable flow transmitter is interfaced to Mark-V using HART to loop. HART for loop converts a digital multivariable signal into three independent 4-20 mA analog signals. Each GTG has identical flow metering set up installed for energy measurement and recording purpose. Existing onfice sizing is done for 200°WC DP which is not in compliance with the requirement of SAUDIA ARAMCO Material Specification Standard 34-SAMSS-112. New orifice must meet the requirements of 34-SAMSS-112. The each GTG has separate metering facility for recording the net inflow (energy) to the respective gas turbine for comparison and checking of net energy flow received from the ARAMCO. For each GTG unit sales flow measurement is performed downstream side of filter skild for consumption of sales gas. Multi Variable transmitter based Flow meter installed on downstream side of filter skild of each GTG to record the energy consumption of each GTG unit. The Total energy consumption of facility (GTG 1 to GTG9) shall be the sum of the total energy supplied by ARAMCO. However energy consumption of each GTGs in matching with total inflow of energy received from ARAMCO.	The metering tube gas flowmeter is not designed for the operation described for monitoring the gas Bling from Aramco. A different meter will be needed to meet this specification. A concillos is recommended here, 0, 0, 0, 0	bilder shall recommend coriolis flow meter as deviation from orifice meter SALS Y-101, as per SAES-Y-101, the required flow meter type is onlice based flowmeter. MARAFIQ will review and approve the deviation taken by bilder. Bilder to specify how Coriolis Flowmeter will be utilized for volumetric flow measurement at standard conditions as required for billing. The sugBildderstsed flow meter type is Conolis Flowmeter and the fiscal flow measurement system shall be fair and impartial to all parties concerned (i.e.MARAFIQ) and ARAMCO). How will bilder propose to install coriois flowmeter since existing Sales Gas piping is routed on grade level & there is no cleamce between pipe and ground level? Installation of coriolis tyep flowmeter requires in num clearance between pipe and groubild to accomplate coriolis flow meter.	be modified accordingly and this is already	vanation in RFP stated Bidder shall
23/6	4	De a led Scope Of Work	4, R.1	METER & OTHER FIELD	The scope of work is EPC which includes detailed engineering design, supply, procurement, installation, testing and commissioning to established satisfactory operation of multi variable flow transmitter for frame ZE GTG units # 1 to 8 and frame ZEA GTG Units # 7. The Contractor shall replace the existing orfice with new onfice. The Contractor's scope includes design, supply, installation and testing of new orfice on fuel gas supply line to each GTG. The multi variable type flow transmitter shall include but not limited to the following:	0, PLEASE LIST ALL REQUIREMENT AND REMOVE BUT NOT LIMITED TO, 0, 0, 0, 0	RFP marking the replacement of existing orifice based flow meter with new orifice per Saudi Aramco standard # ES-Y- t0 t.	Open GE is not replacing the onfice plate	Tender/RFP condition prevails.Any variation in RFP stated Bidder shall submit Oevation from specifications under Form of proposal (As per page no 15 of 15 under Form of Proposal)
2465	4	Detwied Scope Of Work	4. T	REPLACEMENT OF GTG3 # 1 & 8 SECONDARY UNIT AUXILIARY 4, 16 / 0.48 KV DRY TYPE TRANSFORMERS (2 NOS)		Is this expected to be replace in kind 7, 0, 0, 0	Bidder's query is not clear. The transoformer shall be provided as specified in RFP	Noted	
2512	4	Detailed Scope Of Work	4.T. 2	REPLACEMENT OF GTGs # 1 & 8 SECONDARY UNIT AUX:UARY 4.16 / 0.48 KV DRY TYPE TRANSFORMERS (2 NOS)		0, Please I st all requirements and remove * BUT NOT LIMITED TO*, 0, 0, 0	Bidder to follow RFP requirement. Site tests in accordance with the relevant IEC or IEEE standards shall be carried out by CONTRACTOR.	No:ed:	
2520	4	Detailed Scope Of Work	4. U. t	GTG PERFORMANCE TEST AND TRAINING	The purpose of this project is to conduct performance Test for Gas Turbine frame 7E No. t — 8 with and without HRSG. Also to provide On/Off Site Performance Training as specified in Item # 6. The offisite Training Course shall be given before the onsite Performance Test to make Marafiq Staff aware about the methodology of conducting the performance test. All training costs and expenses, training materials, manuals, and use of training facilities costs shall be borne by Contractor	cycle/combined cycle Expences. Meaning of training facilities costs, 0, 0, 0	Noted	Cloyed	
2602	4	Detailed Scope Of Work	4 U, t	GTG PERFORMANCE TEST AND TRAINING	The Reliability Test will be carried out without failure or interruption for a continuous 30 days period (One month) as specified in the RFP. The Reliability Test will be after plant Performance Tests. Contract should include a part for Reliability Test Procedure, Recording and Reporting Reliability Test Results and Monitoring the Reliability Test. Marafig shell review the report and within (14) working days or two (2) weeks. Marafig shall inform the contractor whether the test is successful and accepted.	0, Require detailed clarification from Marafig prior to Bid submittal, 0, 0, 0	Noted	Closed	

Note

MARAFIQ has major concerns (such as Auxiliary Power supply provision, space availability at site etc.), about the feasibility of installing the 'Static Excitation System' proposed. Bidder should check whether the offered system is fully compatible with existing system and arrangement. Otherwise, they have to propose alternative solutions, such as the Brushless type Rotating Exciter (as installed in our GTG #9).

Existing plant addition space may not be possible in between turbines. Bidder has to study the feasibility of their excitation plan including the layout arrangement. The proposal should be supported by a realistic layout plan compatible with the existing space availability at site.













Subject : Pre bid clarification # 4 Clarification # 1-159 Related Scope Description Sub-section ITEM REP Section Title **BIDDER'S CLARIFICATION (June 10th)** MARAFIQ RESPONSE Status Comments section /page MARAFIQ intends to go for GTG frame 7001E rehabilitation by General Tender condition prevails. GTG performenace replacing the Major Parts, since all Gas Turbine Generator's rotors test shall be conducted per ASME PTC 22 INFORMATION TO Are there defined performance goals that Pre-Bid 3 1.2 have reached to 200K and following Major Items need to be replaced BIDDERS post rehabilitation for each GTG as a must be met? , , , , Clarification #4 performance goal. General MARAFIQ shall have the right to revise scope of the work items either Not acceptable to MARAFIQ as stated by by increasing the value of work or by reducing the number of scope bidder. Tender Condition prevails. MARAFIQ Noted, however, for decreasing the scope, items. In such cases the contract shall be amended accordingly. has the right to reduce the scope before GENERAL GE shall be reimbursed for any cost incurred, Pre-Bid 2 awarding of the contract. There is no legal 86 2. 12. a) REQUIREMENTS DETAILS MUST BE DISCUSSED AND Clarification #4 binding from bidder's side. Stated clause in AGREED PRIOR TO BID SUBMISSION, . . SOW is applicable before awarding of the contract. Replacement of MCC for GTGs 1 - 7. General Clarification needed is not clear. GE to check TECHNICAL , , , the load list discripancy will be sent in Pre-Bid correctness of all documents as required by 3 3. 16, Q. REQUIREMENTS Clarification #4 separate sheet Replacement of 4.16 kV Switchgear for GTGs # 1,2,3,4,6,7 & 8 General Noted **TECHNICAL** , , , Dimensions and protection will be Pre-Bid 247 3 3, 16, S, REQUIREMENTS checked at site Clarification #4 INSTALLATION OF Work shown upon the drawings and not mentioned or described in Tender condition prevails. Bidder shall NOX CONTROL the Specification and work described in the Specification and not beresponsible to identify any additional work SYSTEM FOR GTG shown on the drawings will be held to be included in this Contract. requiered to execute which is not mentioned UNITS 1-8 either in SOW or in proposal drawings or Scope should be explicitely defined. Any reference drawings. This exercise shall be Detailed Scope Of additional scope shall be agreed upon Pre-Bid 416 4 4. B. 2 performed by bidder before submitting the Work addedums during a bidding stage or through Clarification #4 a change order if contract was signed, , , , If scope is not clear to bidder, bidder shall raise the appropriate queries not generalized queries INSTALLATION OF Steam Injection and DLN 1 control will accommodate the additional DLN technology is developed by manufacturer. NOX CONTROL I/O capability Mark Vie for all the Units So bidder must answer . MARAFIQ is not fully SYSTEM FOR GTG 4. B. B aware requirement of DLN. Detailed Scope Of No Steam Injection is required, please Pre-Bid 607 4 UNITS 1-8 (OPTION-2) confirm., , , , Bidder to refer steam injection as water Work Clarification #4 injection. The Contractor shall replace existing single pair and multi-pair high REPLACEMENT OF Bidder's understanding is partially correct. Duct AC/DC POWER. temperature cables wired to JB-19 and JB-30. All field instruments bank is not going to be replaced. However CONTROL & cables which are wired from fuel gas control valve to JB-30 through exsiting conduits will be replaced, rerouted as INSTRUMENTATION intermediate junction box shall also are replaced with identical one. required based on the actual site assessment SIGNAL CABLES Existing multi-pair cables of JB-30 shall be replaced with silicone during execution. FOR GTG UNITS 1-8 insulated high temperature instrumentation signal cables as shown in drawing# 10S-261-067. New multi pair field instrumentation signal cables shall be routed in existing conduit, duct bank and trenches and shall be terminated in existing Mark-V cabinet. Refer existing . , , It is understood that duct banks and Detailed Scope Of Pre-Bid 1097 4 4. H. 1 drawing# 16075-2E-0-0016 for cable routing. conduits are not going to be replaced, please Work Clarification #4 confirm Cable routing: Existing cables are laid down through various duct banks, trenches and rigid conduits. The Contractor shall strictly follow the existing routing for replacing high temperature cables for existing junction boxes. Existing routing of cables inside accessory compartment and turbine compartment shall be followed for cable replacement.

MARAFIQ PROCUREMENT & CONTINUES HEIT.

1105	4	Detailed Scope Of Work	4. H. 1	REPLACEMENT OF AC/DC POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-8	characteristics.	provided	Bidder to comply and provide as per MARAFIQ Guide line specifications. MARAFIQ guidelien specifications are already part of RFP. Bidder to refer following MARAFIQ guideline specifications: MQ-SP-E-6018, MQ-SP-E-6019,MQ-SP-6020 and MQ-SP-6021	Pre-Bid Clarification #4
1112	4	Detailed Scope Of Work	4. H. 1	REPLACEMENT OF AC/DC POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-8	ASTM B8 class B stranded annealed copper conductor unless otherwise shown.	, , , , as applicable	Bidder to comply and provide as per MARAFIQ Guide line specifications.	Pre-Bid Clarification #4
1117	4	Detailed Scope Of Work	4. H. 1	REPLACEMENT OF AC/DC POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-8	Contractor to Identify the existing power and control cables route, destinations and terminations with lettering or equivalent means before decommissioning of any of the power and or control cables in order to return same installation with new cables and materials.	, , , , cable routing drawings must be provided by MARAFIQ for confirmation. All drawings must be in AutoCad format	MARAFIQ has provided all reference drawings including cable routing drawings to bidder. MARAFIQ has given the existing drawings available in the scan format not editable native file format like AUTOCAD as requested. MARAFIQ can provide the cable routing AUTOCAD drawings if available. Bidder's condition of providing drawings in AUTOCAD is not acceptable to MARAFIQ.	Pre-Bid Clarification #4
1133	4	Detailed Scope Of Work	4. H. 1	REPLACEMENT OF AC/DC POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-8	Receipt by the MARAFIQ of As - Built drawings, Test and Inspection Certificates, Original Drawings etc. as required by this contract	, , , , for the specified scope of supply	Tender condition prevails	Pre-Bid Clarification #4
1135	4	Detailed Scope Of Work	4. H. 1		The required professional services shall include; complete design development, including the review of information provided in the contract documents, preparation of the final as-built drawings and all necessary documents as required, and related other professional services in connection with, as specified herein, except as may be specifically excluded in the contract document.	, , , , This shall be done for the specified scope of supply. MARAFIQ shall give full access to all drawings and shall confirm that all drawings are availabe in Autocad format. All work will be carried by GE subcontractor and no GES company will be required.	Existing drawings are availabled in scan TIFF format not AUTOCAD. The contractor shall transform and utilize existing TIFF format drawings to generate/redraw new drawings in AUTOCAD. Bidder's insistance on providing drawings in AUTOCAD format is not acceptable and shall not affect the work.	Pre-Bid Clarification #4
1136	4	Detailed Scope Of Work	4. H. 1		The engineering and design responsibilities, under this contract, shall include to research, obtain and apply design information on relevant existing system drawings &design documents by utilizing technical documents from the Owner's files, available in documentation center in the P&W complex.	. , , . This shall be done for the specified scope of supply. MARAFIQ shall give full access to all drawings and shall confirm that all drawings are availabe in Autocad format	Existing drawings are availbel in scan TIFF format not AUTOCAD. The contractor shall transform and utilize existing TIFF format drawings to generate/redraw new drawings in AUTOCAD. Bidder's insistance on providing drawings in AUTOCAD format is not acceptable and shall not affect the work.	Pre-Bid Clarification #4
1139	4	Detailed Scope Of Work	4. H. 1	REPLACEMENT OF AC/DC POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-8	55 PVC Insulated Cables with Circular Copper Conductors	, , , , as applicable	Bidder to comply and provide as per MARAFIQ Guide line specifications.	Pre-Bid Clarification #4







1140	4	Detailed Scope Of Work	4. H. 1	REPLACEMENT OF AC/DC POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-8	Circular Copper Conductors	, , , , as applicable	Bidder to comply and provide as per MARAFIQ Guide line specifications.	Pre-Bid Clarification #4
1159	4	Detailed Scope Of Work	4. H. 1	REPLACEMENT OF AC/DC POWER, CONTROL & INSTRUMENTATION SIGNAL CABLES FOR GTG UNITS 1-8	Testing & Commissioning documents: Submit all testing and commissioning procedures and subsequent test reports subject to Marafiq approval.	, , , , For the specified scope of supply	Tender condition prevails	Pre-Bid Clarification #4
1218	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8	2. The new relays and other auxiliary devices shall be installed in the existing panels. Modifications required in the existing panels for installing the new protective relaying system shall be part of the scope under this contract. The relays 64-1A/G1, 64-1B/G1 (For GTG-1, 3 & 7) and 64-1A/G2, 64 1B/G2 (For GTG-2, 4 & 8) i.e. generator ground fault relay presently available in corresponding panel NP-03 are to be accommodated in the new panel, leaving panel NP03 unaffected in present position. The openings for the replaced relays shall be closed by blanking plates. The generator field ground fault relay and AC exciter field ground fault relay 64F/G1, 64F/EX1 for GTG-1 and 64F/G2, 64F/EX2 located in corresponding AVR cubicles are to be replaced with new relays in their present locations. Any modification in existing panel for accommodating the new relays is included in scope of works. New lockout relays will be provided in the protection panel. The lockout relays shall be separate from multifunction relays and shall be of 'Electroswitch' make.	. , , , We assume limitation on this scope since the exisitng is OLD type relays and the dimnesions might not work with the new relays	Your response is not to the point. Please respond our queries pointwise.	Pre-Bid Clarification #4
1219	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8	Only the protection relays of make ABB, SIEMENS, ALSTOM (AREVA) or GE are acceptable. The relays shall comply with IEC 61850 communication capability.	, , , The existing system is not supporting IEC61850 protocole. Please clarify the need for this ? compliance to IEC 61850 depends on the existing system / Scheme)	The SOW is asking for complience of new relays with IEC 61850. Existing relays are replaced by new relay so every thing is new. Where is the need for compliance with existing system?	Pre-Bid Clarification #4
1236	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8	Preparation of "As-Built" drawings including revision of affected existing drawings to "As-Built" conditions. Some of the drawings for existing systems will be completely replaced by the new system drawings such as protective relaying one line diagram and wiring/ schematic diagrams. Contractor shall study the existing drawings in detail to achieve the similar functionality and interfaces, as a minimum.	, , , , Matafiq to provide the required existing drawings in AutoCad format. Full access to library must be provided if needed	The Contractor shall retrieve all drawings from MARAFIQ library/documentation section.	Pre-Bid Clarification #4
1237	4	Detailed Scope Of Work	4. K. 2	PROTECTION	A detailed cut-over plan to ensure that unscheduled power outages will not occur. The plan shall provide a full work sequence schedule with duration of all work activities shown. The plan shall be submitted to Marafiq for approval at least three (2) months prior to beginning of work in this area.	, , , , GE is not working on any life equipment. This is NA	Clarification needed is irrelavant. What do you mean by life equipment? GE to submit the plan for the work to be done by GE.	Pre-Bid Clarification #4
1242	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8	A minimum of one week training for operation and maintenance of protection relay systems shall be provided in or out of Yanbu for minimum of five (5) MARAFIQ personnel.	is this different than what is listed in Section 4.V?,	Confirm that GE will follow the training as per SOW.	Pre-Bid Clarification #4







1278	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8	Internal wiring of flexible, multi-stranded, copper with flame retardant, 90o C, 600V insulation. Control wiring of single conductor with minimum 1.5 sq. mm size. Instrumentation wiring of shielded twisted pairs with minimum 1.5 sq. mm, size cables with overall shield. Minimum conductor size for current transformer leads shall be 2.5 sq. mm. Minimum conductor size for voltage transformer leads shall be 1.5 sq. mm.	, , , , does this mean that we shall also replace all exsiting wires even if the scheme does not require it?	The response of GE is not to the point. Where it is	Pre-Bid Clarification #4
1332	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8		, , , , to be provdied by MARAFIQ	All documents required for bidding purpose are provided to GE. GE to retrive all required documents from MARAFIQ library after award of the contract.	Pre-Bid Clarification #4
1334	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8		, , , , to be provdied by MARAFIQ	All documents required for bidding purpose are provided to GE. GE to retrive all required documents from MARAFIQ library after award of the contract.	Pre-Bid Clarification #4
1335	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8		, , , , to be provdied by MARAFIQ	All documents required for bidding purpose are provided to GE. GE to retrive all required documents from MARAFIQ library after award of the contract.	Pre-Bid Clarification #4
1336	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8	Generator & Transformer Data	. , , , to be provdied by MARAFIQ	All documents required for bidding purpose are provided to GE. GE to retrive all required documents from MARAFIQ library after award of the contract.	Pre-Bid Clarification #4
07	4	Detailed Scope Of Work	4. K. 2	REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8	Name plate detail for unit auxiliary transformer	, , , , to be provdied by MARAFIQ	All documents required for bidding purpose are provided to GE. GE to retrive all required documents from MARAFIQ library after award of the contract.	Pre-Bid Clarification #4
1341	4	Detailed Scope Of Work	4. L. 1	600V DRAW OUT METAL CLAD	The work under this contract is to complete replacement and modify the existing system & includes the work of Engineering, Design, Supply, Transportation, Fabrication, Installation, testing and Commissioning of three (3) outdoor type 600 Volts draw-out Metal Clad Switchgears, floor mounted, using stored energy type air circuit breakers, for any three (3) of Gas Turbine Generator (GTG) units; connecting and retrofitting with an existing secondary units auxiliary transformer 1500kVA, 4.16kVA/480V, 3-phase. Disconnection, dismantling and safe disposal of the existing switchgears. Reconnections of the power feeders to the transformers and local and remote control wiring of new switchgears in the field at power generation facilities. New switchgear shall utilize the state of the art of the latest technology and components that are functionally compatible with existing components and equipment. Contractor shall be totally responsible for all activities necessary to produce engineering and design documents and installation and construction works that are acceptable to owner. All works shall be carried out in accordance with contract documents.	, , , , We assume MARAFIQ will not impose the utilization of General engineeringconsultansuch as JACOBs or Saud consult	It will be finalized later.	Pre-Bid Clarification #4









1345	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	All the loads presently supplied from the existing switchgear will be reconnected to the new switchgear. The existing cables & conduits disconnected from the existing switchgear shall be reconnected to the new switchgear. No joints are allowed in cables.	, , , , we assume the existing cables & temrinations are in good conditions and if require replacment it will be carried with additional cost	All healthy cables shall be reused. All faulty cables shall be replaced by GE. GE to quote unit rate of installation for cables.	Pre-Bid Clarification #4
13	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	The contractor shall be responsible for research and identify MARAFIQ / Royal Commission documents and drawings necessary to work but not be included with the documents. The contractor shall be responsible for retrieval of those documents.	, , , , We understand this shall be Client scope to provide	It is clearly written in SOW that it is contractor's responsibility, then why this query?	Pre-Bid Clarification #4
1354	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	Site survey and field verification of existing facilities to develop detailed design work.	, , , , Marafiq to be present in order to faciltate any requirements	MARAFIQ will provide access for the survey. MARAFIQ will not be present with GE engineers all the time.	Pre-Bid Clarification #4
1361	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	As part of the complete design development responsibility, the contractor shall assume the following as minimum: If the design requires additional components for correct and safe operation then the contractor shall furnish and install those components either in the existing or in the new system.	, , , , Will be provided with additional cost since at this stage we are not familiare with system operation	All required data for quotation is supplied to GE. GE should include all cost before award of the Contract.	Pre-Bid Clarification #4
1362	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	The contractor shall be responsible for obtaining all required information from existing design documents, operation and maintenance manuals and specification as necessary to perform the design.	, , , , Marafiq shall provide all required access and confirm the availability of information in their library	The Contractor shall coordinate with documentation section of MARAFIQ to retrieve required document.	Pre-Bid Clarification #4
1363	4	Detailed Scope Of Work	4. L. 1		The contractor may use the information on existing as-built drawings to the extent possible in his design. However, it shall be the responsibility of the contractor to verify in the field the as-built conditions wherever necessary, especially for interfaces, and prepare complete sets of comprehensive new design drawings.	.,,, Drawings and all required informatoion to run the engineering design must be available. Marafiq to provdie HARD copy and Autocad of the existing drawings	The Contractor shall coordinate with documentation section of MARAFIQ to retrieve required document.	Pre-Bid Clarification #4
1364	4	Detailed Scope Of Work	4. L. 1		The contractor's responsibility shall also include a verification of adequacy of existing systems, equipment and extension of these facilities to the new system and equipment.	, , , , Will be provided with additional cost since at this stage we are not familiare with system operation	GE shall furnish all cost during bidding stage.	Pre-Bid Clarification #4
1385	4	Detailed Scope Of Work	4. L. 1	600V DRAW OUT	As part of the design work, contractor is responsible for research and retrieval of all related drawings and other information from MARAFIQ technical Library, as required for the design and integration of the new switchgear.	, , , , Marafiq to confirm availability of the required information	The Contractor shall coordinate with documentation section of MARAFIQ to retrieve required document.	Pre-Bid Clarification #4
1393	4	Detailed Scope Of Work	4. L. 1	600V DRAW OUT	The contractor shall guarantee the availability of spare parts of the Metal Clad Switchgears and all related equipment for about 15 years of the equipment life in order to avoid early obsoleteness.	, , , , Availablity of replacement parts or alternatives is confirmed	Noted.	Pre-Bid Clarification #4





1395	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	refernced Standards: All materials and equipment of the draw-out Metal Clad Switchgear including all components shall be designed, manufactured and tested in accordance with the latest issues of relevant International Electrochemical Commission (IEC) and/or ANSI standards. When IEC standards are not relevant or in existence, use other applicable standards listed below. Internationally accepted standards of the manufacturer's country may be approved for use provided they are equivalent to applicable standards other than listed below, a comparison table shall clearly show the equivalency between substitute standards listed below. Any conflict between the specification and reference codes and standards shall be brought to MARAFIQ attention for a written resolution. Comply with applicable provisions of the following latest standards except as otherwise specified.	, , , . LV switchgear is not metal clad	Bidder to follow SOW.	Pre-Bid Clarification #4
1401	4	Detailed Scope Of Work	4, L, 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	Royal Commission Electrical Code (RCEC).	, , , , to be provided	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
1402	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	General Design Criteria and Technical Guidelines	, , , , to be provided	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
1484	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	Bus bars shall be made of copper with welded type connections or tin plating at bolted type connections. The bus bars shall be braced to withstand 25 MVA symmetrical short circuit level.	42 KA	GE to confirm the symmetrical short circuit rating as per SOW.	Pre-Bid Clarification #4
1485	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	Low Voltage switchgear shall be metal enclosed outdoor type product.	, , , , this will be indoor switchgear with WALK in enclsoure	GE to comply with SOW. Ther is no need of walk in enclosure.	Pre-Bid Clarification #4
1508	4	Detailed Scope Of Work	4. L. 1	600V DRAW OUT METAL CLAD	Air circuit breakers (ACB) draw-out type complete with microprocessor based protective relay for Long Time, Short Time, Instantaneous & Ground fault (LSIG) protection, CT's, indicating lamps and associated auxiliaries.	, , , , relays are solid state	GE to comply with SOW.	Pre-Bid Clarification #4
1515	4	Detailed Scope Of Work	4. L. 1	REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8	Circuit breaker preferred manufacturer is ABB.	, , , , it shall be as per the offer which will be sent with our techno commerical proposal	GE to comply with SOW.	Pre-Bid Clarification #4

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1802	4	Detailed Scope Of Work	4. N. 1	HYDROGEN CONTROL PANEL	The purpose of the project is to provide two Hydrogen Control and Gas Purging Control Panels in GTG units 3 - 8 on a turnkey contract to provide a reliable and accurate measurement of Hydrogen pressure, Hydrogen purity (% Hydrogen in Air), and purge gas measurement (% H2 in CO2 and % Air in CO2) in the generator housing to ensure safe and efficient operation. The new Hydrogen Control Panel and the Purging Control Panel shall be state-of-the art preferably OEM supplied hydrogen control / monitoring system to replace fully the existing Hitachi Hydrogen Control and Purging Control panels. Alternatively panels equipped with Yokogawa analyzers or Teledyne analyzers shall be acceptable provided they meet the requirements as per philosophy of existing system. The new panels as a minimum shall provide all the existing local / remote control and monitoring functions. The signals transmission interface with local facilities and MARAFIQ Central Control Room (CCR) in Central Control Building (CCB) for monitoring will remain the same as existing except as described in interface.	Marafiq recently installed two (2) new H2 panels on units 1 & 2, need Marafiq to provide the details of the vendor in order for GE purchase similar panels for the remaining units.,,,,	New installed H2 panels and H2 purity analyzers are of YOKOGAWA make. Bidder to retrieve the drawings, documenst and manuals from MARAFIQ documentation centre for newly installed H2 panels. However in proposal bidder has mentioned to replace the existing generator with air cooled generator. Bidder to confirm does MARAFIQ need H2 panel for air cooled generator also.	Pre-Bid Clarification #4
2251	4	Detailed Scope Of Work	4. Q. 1	REPLACEMENT OF MCC FOR GTG 1-7	Presently there are 9 x 60MW capacity gas based power generating units that are in operation at MYAS at Yanbu. For supply of power to the unit auxiliaries, 4.16 KV metal-clad switchgear has been installed which supplies power to the 480V switchgear through a transformer and other loads at 4.16KV. One of the 480V switchgear outlet supply power to 480 V MCC panel installed in the auxiliary compartment. This MCC panel supplies power to various generator auxiliaries. The single line diagram for the system is as per Section 4.0, List of Reference Drawings. The existing indoor type of Hitachi make 480V MCC switchgear assembly units consist of draw out type cubicles with 600V MCCBs (Terasaki make) of various current ratings. It is required that this existing MCC panel be replaced with new MCC panel with a view to improve the plant reliability. The existing breakers in the MCC panel do not have the ground fault protection facility. It is required that the new panel will have the breakers having ground fault protection capability. This replacement of MCC panel is to be carried out for one GTG unit only.	.,,, we are offering complete LV MCC replacment	Noted.	Pre-Bid Clarification #4
]] 2263	4	Detailed Scope Of Work	4. Q. 2	REPLACEMENT OF MCC FOR GTG 1-7	The Contractor shall as part of his full responsibility and scope shall check the ratings of and/or sizes of those components whose ratings or sizes are specified in the Contract document. When this check indicates that the specified ratings or sizes are not adequate, then the Contractor shall make necessary changes at no extra cost to MARAFIQ. The supply and installation of the 480V MCC panel with all associated accessories shall include the following:	drawings , data sheets, load list . We shall provdie the LV MCC with the same load list and if in future additional loads are required	GE to follow SOW.	Pre-Bid Clarification #4
2281	4	Detailed Scope Of Work	4. Q. 2	REPLACEMENT OF MCC FOR GTG 1-7	Preparation of As-Built drawings including revision of existing interface drawings (originals) to as built condition.	, , , , existing substation layout must be provided in AUTOCAD FORMAT. This is also applicable for all LV MCC interface equpiment	GE to retrive all documents from MARAFIQ library. GE should prepare all the drawings in the format same as those retrieved from MARAFIQ library.	Pre-Bid Clarification #4









			11	REPLACEMENT OF MCC FOR GTG 1-7	Following drawings pertaining to the existing MCC unit are enclosed for reference in Section 4.0, List of Drawings.			
2282	4	Detailed Scope Of Work	4. Q. 2		006Q-P01-674 One Line Diagram of Unit 480V, 120/208V and 125V DC 331DF15184 Outline of Auxiliary Control Compartment 331QF29461 Motor Control Center 006Q-P01-673 One Line Diagram of GT Generator and Unit Substation The single line diagram of the new MCC is enclosed in Section 4.0, List of Drawings.	, , , , Descipancy noted , MARAFIQ to confirm the correct load list	Contractor to verify the correctness of existing documents as required by SOW.	Pre-Bid Clarification #4
2289	4	Detailed Scope Of Work	4. Q. 2	REPLACEMENT OF MCC FOR GTG 1-7	The site conditions under which the Motor Control Center is required to operate are as below: 1. Room temperature, air conditioned (A/C) 25 deg C 2. Room temperature, A/C off 50 deg C	, , , , LV MCC will be designed room tmep of 35 Deg C and contorlled environment	GE to follow SOW.	Pre-Bid Clarification #4
2308	4	Detailed Scope Of Work	4. Q. 2	REPLACEMENT OF MCC FOR GTG 1-7	Each MCC shall be provided with a main copper ground bus not less than 50x6 mm in cross section running the entire length of control center.	, , , , as per LV MCC desgin	GE to follow SOW.	Pre-Bid Clarification #4
] ²³⁰⁹	4	Detailed Scope Of Work	4. Q. 2	REPLACEMENT OF MCC FOR GTG 1-7	All enclosure parts shall be thoroughly cleaned and given a phosphatizing treatment to inhibit rust and to prime the metal for finish coating. A-2 mil thick electrostatic powder paint coat shall be applied to all surfaces. The paint type and process shall meet UL1332 for electrical equipment steel enclosures. All exterior enclosure covers and doors shall be painted with ANSI 61 grey. For improved interior visibility the interior of the enclosure and plug in units shall be painted white.	, , , , We assume rust inhibitor is not required and not applicable for contorlled environment	GE to follow SOW.	Pre-Bid Clarification #4
2315	4	Detailed Scope Of Work	4. Q. 2	REPLACEMENT OF MCC FOR GTG 1-7	Contractor shall match the size of the new MCC with that of the existing MCC. The sequence of order of all the feeders in new MCC shall match with that of the existing MCC so that the cable length is not a problem while re installation. If warranted due to any structural difference with existing MCC, the Contractor shall lay new cable falling short for connection to new MCC. No cable joint will be permitted.	, , , , we shall try fit as per the dimensoin limitation, however this will only be confirmed during detialded design	GE to follow SOW.	Pre-Bid Clarification #4
2403	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Preparation of As-Built drawings including revision of existing interface drawings (originals) to as built condition.	, we assume the modification of the affected drawings in the switchgear provided all AUTOCAD drawings of the switchgears are available and accessable	GE to retrive all documents from MARAFIQ library. GE should prepare all the drawings in the format same as those retrieved from MARAFIQ library.	Pre-Bid Clarification #4
2406	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	The existing draw out positions of connects, test and disconnect for the existing circuit breakers should match with that of the new circuit breakers.	, , , , to be oconfirmed during detialed desgin	GE to follow SOW.	Pre-Bid Clarification #4
2410	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Any other hardware available on the metal clad switchgear assembly which is used for racking in and racking out of the circuit breaker in test, connect and disconnect positions should be properly interfaced for the new circuit breakers.	, , , , to be confirmed during detialed deisgn	GE to follow SOW.	Pre-Bid Clarification #4
2411	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	The switchgear including all components shall be designed and manufactured in accordance with the following applicable latest standards. Any conflict between the specification and reference codes and standards shall be brought to MARAFIQ attention for a written resolution.	, , , , NA if we are replacing breakers only	Noted.	Pre-Bid Clarification #4









2412	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	International electro technical commission (IEC)	, , , , As appicable to the existing	GE to follow SOW.	Pre-Bid Clarification #4
2413	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	American national standards institute (ANSI)	, , , , As appicable to the existing	GE to follow SOW.	Pre-Bid Clarification #4
2414	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Institute of electrical and electronics engineers (IEEE)	, , , , As appicable to the existing	GE to follow SOW.	Pre-Bid Clarification #4
2416	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	The circuit breakers shall be horizontal draw out, vacuum type, 3 pole single throw, capable of being racked out from the fully disconnected position, through the test position, to the fully connected position, with the breaker compartment door closed. Guide and racking mechanism shall be adequate to perform this function without the application of undue force and with complete safety. The breakers shall be operated by a motor charged stored energy springs mechanism, charged normally by a universal electric motor and in emergency by a manual handle.	, , , , as applicable of the exsiting retorfill	GE to follow SOW.	Pre-Bid Clarification #4
2417	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	The three interrupter poles shall be mounted on glass polyester supports. A contact wear gap indicator shall be provided for each interrupter which requires no tools to indicate available contact life and shall be easily visible when the breaker is removed from its compartment.	, , , , wear gage might be required	GE to follow SOW.	Pre-Bid Clarification #4
2421	4	Detailed Scope Of Work	4, S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Circuit breakers shall be provided with control switch with red "closed" and green "open" indicating lights for closing and tripping the breakers in the test and operating positions. Each circuit breaker shall be provided with a visible mechanical indicator connected to the breaker operating mechanism so that the "open", "close", "trip" status is indicated through the front door of the cell. Position indication "operating", "test", "disconnected" shall also be provided.		GE to follow SOW.	Pre-Bid Clarification #4
2422	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Circuit breakers controlled from remote locations shall be provided with a door mounted two position "local" and "remote" selector switch. Remote control shall be prevented when the switch is in "local" position. With the switch in "remote" position open and close control shall be possible only in the operating position. Interlock shall be provided to prevent remote control of the breaker when in the test position. A remote common alarm shall be provided at the local control room and also at the central control building (CCB) to indicate when a control switch has been turned to the local position.	, , , , this means the switchgear might also need to replace some contorl schemes!! MARAFIQ to confirm	GE to follow SOW.	Pre-Bid Clarification #4
2423	4	Detailed Scope Of Work	4. S. 2			, , , , this means the switchgear might also need to replace some contorl schemes!! MARAFIQ to confirm	GE to follow SOW.	Pre-Bid Clarification #4

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2425	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Circuit breakers shall be electrically operated with stored energy operating mechanisms. Each breaker shall be equipped with a visible indicator mechanically connected to circuit breaker mechanism and located so that the close or trip status of the breaker is indicated through front door of the cell. In addition the breaker shall also be equipped with a position indicator which shows exactly where the breaker is without opening the door. Visual indication (light) shall be provided to indicate that the control circuit is healthy and the breaker is ready to close, Indication shall be provided to indicate the spring charged condition.	, , , , details will be prvodied during the detialed desgin and based on the exisitng switchgear	GE to follow SOW.	Pre-Bid Clarification #4
2426	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Interlock shall be provided to prevent moving a closed circuit breaker in the cell, to prevent closing of a breaker between operating and test positions, to trip breakers before access can be gained to the racking mechanism upon insertion or removal from the housing. The stored energy mechanism must be discharged when the breaker is moved in the cell. The stored energy spring status shall be indicated "charged" or "discharged". The breaker shall be secured positively in the housing between and including the operating and test positions.	details will be prvodied during the	GE to follow SOW	Pre-Bid Clarification #4
2427	4	Detailed Scope Of Work	4. S. 2	GTG UNITS # 1, 2, 3,4,6,7 & 8	Each breaker shall be provided with a manual trip push button which mechanically trips the breaker. The manual trip push button and its associated breaker trip linkage shall have no common components with the electrical trip mechanism except the final breaker release device. The push button shall be operable from outside without having to open the door.	, , , , push button is located in the beaker	GE to follow SOW.	Pre-Bid Clarification #4
2428	4	Detailed Scope Of Work	4. S. 2	SWITCHGEAR FOR	A two pole circuit breaker shall be furnished in each switchgear assembly for incoming 125V dc control power supplies. The breaker shall be installed preferably in the incoming breaker cubical or auxiliary cubical of the switchgear assembly.	, , , , details will be prvodied during the detialed desgin and based on the exisitng switchgear	GE to follow SOW.	Pre-Bid Clarification #4
2440	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	One line diagram	, , , , all AUTODCAD drawings of the exsiting switchgear shall be provided	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2441	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Outline and arrangement dimensional drawing	, , , , all AUTODCAD drawings of the exsiting switchgear shall be provided	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2442	4	Detailed Scope Of Work	4. S. 2		Material list	, all AUTODCAD drawings of the exsiting switchgear shall be provided	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2443	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Layout and installation detail drawing	, , , , all AUTODCAD drawings of the exsiting switchgear shall be provided	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2444	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Schematic diagrams (Control schemes)	, , , , all AUTODCAD drawings of the exsiting switchgear shall be provided	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2445	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4.6.7 & 8	Wiring diagrams	, all AUTODCAD drawings of the exsiting switchgear shall be provided	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4

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2446	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Conduit entry/exit locations	, , , , all AUTODCAD drawings of the exsiting switchgear shall be provided	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
9	4	Detailed Scope Of Work	4. S. 2	REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8	Certification shall be provided to show that the type tests were successfully performed on breakers identical to those being provided under this contract. Also the parts (involved in 4.16KV circuit) designed for interfacing the new breaker with old switchgear assembly unit will be type tested as per relevant standards.	, , , , type test certificate of Breaker will be provided, however, inteface testing with the exsitnig switchgear will not be type tested.	GE to follow SOW.	Pre-Bid Clarification #4
2470	4	Detailed Scope Of Work	4. T. 1	REPLACEMENT OF GTGs # 1 & 8 SECONDARY UNIT AUXILIARY 4.16 / 0.48 KV DRY TYPE TRANSFORMERS (2 NOS)	Outline of 4.16 k V – 1500 / 2000 k VA dry type transformer cubicle	. , , , MARAFIQ to provdie the drawing	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2471	4	Detailed Scope Of Work	4. T. 1	REPLACEMENT OF GTGs # 1 & 8 SECONDARY UNIT AUXILIARY 4.16 / 0.48 KV DRY TYPE TRANSFORMERS (2 NOS)	Existing installation of 4.16 k V and 600 V Metal Clad Switchgear	, , , , MARAFIQ to provdie the drawing	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2472	4	Detailed Scope Of Work	4. T. 1	REPLACEMENT OF GTGs # 1 & 8 SECONDARY UNIT AUXILIARY 4.16 / 0.48 KV DRY TYPE TRANSFORMERS (2 NOS)	Partial One line diagram of Secondary Unit Auxiliary Transformer.	, , , , MARAFIQ to provdie the drawing	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2473	4	Detailed Scope Of Work	4. T. 1	REPLACEMENT OF GTGs # 1 & 8 SECONDARY UNIT AUXILIARY 4.16 / 0.48 KV DRY TYPE TRANSFORMERS (2 NOS)	Existing transformer name plate information	, , , , MARAFIQ to provdie the drawing	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2493	4	Detailed Scope Of Work	4. T. 2	REPLACEMENT OF GTGs # 1 & 8 SECONDARY UNIT AUXILIARY 4.16 / 0.48 KV DRY TYPE TRANSFORMERS (2 NOS)		, , , , we shall provide the transfomer with similar rating and no calcualtion is assumed to be required	GE to follow SOW.	Pre-Bid Clarification #4
2504	4	Detailed Scope Of Work	4. T. 2	REPLACEMENT OF GTGs # 1 & 8 SECONDARY UNIT AUXILIARY 4.16 / 0.48 KV DRY TYPE TRANSFORMERS (2 NOS)	Preparation of "As built "drawings including revision of existing drawings to as built condition.	, , , , MARAFIQ TO provide the existing layout in AUTOCAD format	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2557	4	Detailed Scope Of Work	4. U. 1	GTG PERFORMANCE TEST AND TRAINING		is this different than what is listed in Section 4.V? Shall the training offer be all in one section (4.V)?, , , ,	GE to follow SOW.	Pre-Bid Clarification #4









2625	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	check requested Capacitiy for Dry Transformer to be 1500kva or 2000kva (To Confirm)	GE to follow SOW.	Pre-Bid Clarification #4
<u>∠</u> ∪∠6	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	check if dial thermometer will be requested to supply with Dry Transformer (To Confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2627	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	Check if Dry Transformer with supply with Enclosure or Separate (To Confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2628	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	if enclosure requested for Dry Transformer its dimensions and spec. must be provided(To Confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2629	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	check if Grounding CT 600/5 will be replaced with another one new inside the enclosure (To Confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2630	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	check if over Current Protection relay requested with dry transformer enclosure or not and it's location, conncections & setting (To Confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2631	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	Transformer Cooling fan will be replaced with new one (Its Btu and spec. requested in case of replaced)(To Confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2632	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	Busbar size and cable connection data Must be Provided (To Confirm)	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2633	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	Drawing of Dry transformer not Provided (To Confirm)	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #4
2634	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	desing Temperature for Transformer will be 50 C or 55 C (To Confirm)	GE to follow SOW.	Pre-Bid Clarification #4









2650	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	what type of control relay requested in separate compartment (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2649	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7		Interence of Cable from top or Bottom (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #
648	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7		General Design Temp will be 50 c or 40 c (Marafiq to confirm)		Pre-Bid Clarification #
647	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7		More Detail required for auxiliary control Compartment (Marafiq to confirm)	Contractor shall retrive all documents required after award of Contract. Necessary documents for bidding purpose are provided.	Pre-Bid Clarification #
2646	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	control Voltage for all equipment will be 120V ac (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #
2645	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	Noted Miss Match between required Motor Starter and Enclosure Design (Marafiq to confirm which one to use)	Contractor to verify the correctness of existing documents as required by SOW.	Pre-Bid Clarification #
2644	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	Battary Charger will not be part of MCC Design (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2643	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7		Scope of replacement will include One MCC FOR 7 GTG or for One GTG (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #
) ²	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	All motor starter qty and K.w as per SLD (Marafiq to confirm)	Contractor to varify the correctness of existing documents as required by SOW.	Pre-Bid Clarification #-
2641	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	Is 50kva 1Ph Transformer required to be Provided inside Panel or not (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #-
2640	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	Main breaker for MCC Panel is not Provided in the drawing (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2639	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	There are still missing Drawings, Marafiq to provide	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #
2638	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	Load Details Must be Provided and Transformer Details for Sizing (To Confirm)	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #
2637	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	Protection relay for Dry Transformer will be replaced or not (To Confirm)	GE to follow SOW.	Pre-Bid Clarification #
6در	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	HV Connection type and its details Must be Provided (To Confirm)	GE to retrive all documents from MARAFIQ library	Pre-Bid Clarification #
2635	4	Detailed Scope Of Work	4. T	Replacement of GTGs # 1&8 Secondary Unit Auxiliary 4.16 / 0.48 Kv Dry Type Transformers	General	Busbar and Cable connected to Transformer will be replaced or not (To Confirm)	GE to follow SOW.	Pre-Bid Clarification









2651	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	Painting ral will be 7035 (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2652	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	Should the Ground fault Protection be required for all outgoing Feeders or incoming Only (Marafiq to confirm)	All outgoing and incomer feeders shall be provided with ground fault protection	Pre-Bid Clarification #4
	4	Detailed Scope Of Work	4.Q	Replacement of MCC For GTG 1-7	General	We need the Existing alarm Circuit Details (Marafiq to confirm)	Contractor shall retrive all documents required after award of Contract. Necessary documents for bidding purpose are provided.	Pre-Bid Clarification #4
2654	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Protection relay Panel for 6 GTG will be replaced or only 2 GTG (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2655	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Each Protection control Panel consist of 4 Sections (Marafiq to confirm)	GE is provided with Protection panel layout drawings.	Pre-Bid Clarification #4
2656	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Missing Drawing for 006s-P06-104, 331DF15182, 331DF22962 (To be Provided)	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4
2657	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Only Protection relays functions as per Section IV k only requested Protection(Marafiq to confirm) GE to follow SOW.		Pre-Bid Clarification #4
2658	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Scada System Details Must be Provided	Existing LDC SCADA is SIEMENS POWER SPECTRUM TG 8.2.	Pre-Bid Clarification #4
5 59	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Scada system available on site have Communiction Protocol IEC61850 or others(Marafiq to confirm)	IEC61850 communication protocol is required for future interfacing and integration . At present there is no SCADA for protection relay. As stated in SOW, "The relays shall comply with IEC 61850 communication capability".	Pre-Bid Clarification #4
2660	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Details of other auxiliary devices to be installed in with new relays Must be Provided(Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2661	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	for generator ground fault relay will be replaced with new One or leaving in NP3 unaffected(Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2662	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Include Connection of existing CT to	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4
2663	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Cable Connection Detials for CT leads shall	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4
2664	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Operation Must be Provided (Marafiq to	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4





2665	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Enclosure of Existing Protection relays Must be replaced (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2666	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	all replaced relays will be Digital type(Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2667	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Current and potential Transformer Quantity , ratios and ratings for output power , burden and accuracy shall be Provided(To confrim)	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4
2668	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	setting of existing relays Must be Provided (Marafiq to confirm)	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4
2669	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	input , Output Signal to Protection control Panel shall be Provided (Marafiq to confirm)	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4
2670	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	The existing Panels includes several types of old Protection relays so we will supply digital type of protection relays which can replace most of the existing relays	GE to follow SOW.	Pre-Bid Clarification #4
2671	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Existing panels needs to be replaced with new panels as we will completely change the design for the panels with its relays and accessories	GE to follow SOW.	Pre-Bid Clarification #4
2672	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Will the existing protection function will be incorporated in our new proposed relay including the AVR protection function since they are housed in a separate panel next to MCC. Please confirm	GE to follow SOW.	Pre-Bid Clarification #4
2673	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	For annunciator and Metering which existing beside Protection Panel it will be replaced also or not (To Confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2674	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	DCS Details must be Provided to consider during selected Protection relays and other accessories component	Bidder's query is not clear. What type of DCS details are required. Bidder has to make proper questionnaire format for required DCS details.Bidder to approach ABB Saudi Arabia for interfacing and integration related DCS details. DCS is ABB Symphony Harmony.	Pre-Bid Clarification #4



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2675	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	Type of Communication Protocol required as spec to be IEC 61850, so we must check if it will be applicable with existing DCS system or not (TO Confirm)		Pre-Bid Clarification #4
2676	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	There are additional instrument for temperature recorder for generator existing in the Protection Panels, it will be replaced also or not (To Confirm)	GE to follow SOW. Temperature Recorder will also be replaced.	Pre-Bid Clarification #4
2677	4	Detailed Scope Of Work	4.K	Replacement of Protection Relay By Digital Type GTG Unit 1,2,3,4,7 & 8	General	is the Gen control panel which located in the same enclosure with RP panel will be replaced with RP panels? if yes it will be kept stand alone or it will be merged with RP panel? Scheme and layout is required	GE to follow SOW.	Pre-Bid Clarification #4
2678	4	Detailed Scope Of Work	4. S	Replacement of 4.16 KV Switchgear for Units 1,2,3,4,6,7 &8	General	removal of the existing 4.16kv air circuit breaker with its stationary Part (Marafiq to confirm)	GE to follow SOW.	Pre-Bid Clarification #4
2679	4	Detailed Scope Of Work	4. S	Replacement of 4.16 KV Switchgear for Units 1,2,3,4,6,7 &8	General	missing Drawing 311-3k20612, 311-3k20611, 311-3k20613, 311-3k20614, 311-2j28109, 311-2m05616 (to be PROVIDED)	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4
2680	4	Detailed Scope Of Work	4.M	REPLACEMENT GENERATOR BREAKER OF GTG UNITS 1, 2, 3, 4, 7 & 8	General	More data about insulation bus connected to existing new breaker of ABB is required	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4
2681	4	Detailed Scope Of Work	General	General contract	General	Do we need to replace all the cables or is Marafiq going to give us the list of damaged cables?	GE to follow SOW.	Pre-Bid Clarification #4
2682	4	Detailed Scope Of Work	General	General contract	General	Marafig needs to provide us the list of	Ge to propose the the manufacturer of cables for MARAFIQ review.	Pre-Bid Clarification #4
2683	4	Detailed Scope Of Work	General	General contract	General	Regarding the cleaning of existing duct banks and conduits, Marafiq needs to give us the	All documents required for bidding purpose are supplied. GE to retrive other documents from MARAFIQ Library after award of contract.	Pre-Bid Clarification #4
2684	4	Detailed Scope Of Work	General	General contract	General	Can Marafiq confirm regarding duct banks and conduits, if all of them require cleaning or have Marafiq marked out those banks and ducts	MARAFIQ SOW includes cleaning of all duct banks and conduits.	Pre-Bid Clarification #4
2685	4	Detailed Scope Of Work	General	General contract	General	For testing of the cables, Marafiq mentioned	Bidder to follow MARAFIQ guideline specifications	Pre-Bid Clarification #4



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2686	4	Detailed Scope Of Work	General	General contract	General	Marafiq needs to furbish I/O tags for their existing SCADA	Bidder to specify why does he need I/O tags for SCADA. MARAFIQ has already provided I/O tag list of existing Mark -V system. Existing Mark-V system is communicating with ABB Sysmphony Harmony DCS using Modbus protocol.	Pre-Bid Clarification #4
7	4	Detailed Scope Of Work	General	General contract	General	The existing SCADA hard wired shall be replaced with fiber optic or it will remain hardwired?	Bidder's query is not in correct context. MARAFIQ SOW does not include any work related to SCADA.	Pre-Bid Clarification #4
2688	4	Detailed Scope Of Work	General	General contract	General	All signals are hardwired, Marafiq needs Marafiq to confirm if there is any communication via radio	There is no communication of signals through radio.	Pre-Bid Clarification #4
2689	4	Detailed Scope Of Work	General	General contract	General	What is the communication protocol with the existing SCADA	Mark-V system is communicating with ABB Sysmphony Harmony DCS using Modbus protocol.	Pre-Bid Clarification #4
2690	4	Detailed Scope Of Work	General	General contract	General	Does Marafiq require us to add new alarms/tags to be added or they are going to use the existing tags which will be in integrated in the SCADA	MARAFIQ requires some signals to be added and integrated to existing ABB Symphony Harmony DCS.	Pre-Bid Clarification #4
2691	4	Detailed Scope Of Work	General	General contract	General	We are assuming that there is no CCR in Marafiq Yanbu and existing SCADA will be working as CCR for this project. Please confirm	ABB Symphony Harmony DCS (UCS-Unified Control System) is located in CCB#13 (Central Control Building) inside PD&SC Complex of MARAFIQ, Yanbu.	Pre-Bid Clarification #4
2692	4	Detailed Scope Of Work	General	General contract	General	Marafiq needs to provide a clear and complete scope of work and detail drawings for the SCADA system?	MARAFIQ has already specified SOW in section 4.4 Speed Tronic from Mark V to Mark VIe upgrades	Pre-Bid Clarification #4
2693	4	Detailed Scope Of Work	General	General contract	General	Can we use the existing SCADA marshalling cabinet, if any or do we need to provide and install a new one?	Bidder's query is not clear. The Mark-Vie system shall be provided as specified in RFP.	Pre-Bid Clarification #4
2694	4	Detailed Scope Of Work	General	General contract	General	Is there an existing SCADA interface panel near the switchgear? If so, please confirm if signals are hard wired or if some other protocol is used.	There is no existing SCADA interface panel near switchgear.	Pre-Bid Clarification #4
2695	4	Detailed Scope Of Work	General	General contract	General	Who is the vendor (Siemens, Schneider Electric, ABB etc) of their existing SCADA	Existing SCADA in LDC is of SIEMENS. However this SCADA is not part of this proposed GTG rehabilitation project	Pre-Bid Clarification #4
2696	4	Detailed Scope Of Work	General	General contract	General	philosophy for their existing control systems	Bidder to contact Gas Turbine manufacturer for control philosophy of Gas Turbine. Bidder shall acquire the existing Mark-V control strategy downloaded in controller.	Pre-Bid Clarification #4
2697	4	Detailed Scope Of Work	General	General contract	General	We didn't see any scope of PLC in Marafiq's scope of work. Should we assume that all the cables are going to be directly terminated into SCADA or there will be an interface of PLCs in between?		Pre-Bid Clarification #4
2698	4	Detailed Scope Of Work	General	General contract	General	If there is PLC required, should it be standalone or redundant	PLC is not required for this proposed rehabilitation project.	Pre-Bid Clarification #4
2699	4	Detailed Scope Of Work	General	General contract	General	If there is PLC required, should it be standalone or redundant	PLC is not required for this proposed rehabilitation project.	Pre-Bid Clarification #4





شركة مرافق الكهرباء والمياه بالجبيل وينبع (مرافق ower and Water Utility Company for Jubail and Yanbu



KINGDOM OF SAUDI ARABIA

Gas Turbine Generators

Rehabilitation by Replacement of

Major Parts - YANBU

Contract PO # 720 002 6909 (Volume 2 of 3) Post Bid Clarifications Attachment C

General Electric International Inc (GEII)

CONTRACT DOCUMENTS







Gas Turbine Generators Rehabilitation by Replacement of Major Parts - YANBU

Contract PO # 720 002 6909 (Volume 2 of 3) Post Bid Clarifications Attachment C

General Electric International Inc. (GEII)



Project: RFP Collective No. YNB-PR6947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-CE-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	
1.	General	GE has to confirm that as a minimum, they are complying with the Civil/Structural Work requirements in Sections 2.5 and 3.4 of the SOW in the bid document.	Confirm	Complied and Closed.
2.	Filename: 1-Marafiq YANBU - Plant Rehab-778781-15- YGTZ-Technical	In Section 4.1.5, there is no mention that GE will provide shades to radiators. Radiators shade must be provided as per bid SOW Section 2.5	It is included as per Marafiq Specs.	Complied and Closed.
3	-do-	All civil/structural foundations and structures shall be provided with detailed design calculations.	Noted	Complied and Closed.
4	-do-	In Page 259 of this document, it states that Civil/Structural works shall be sub-contracted. Please provide the name of the sub-contracting company inclusive of pre-qualification documents not limited to CV's of key personnel, manpower and equipment list, information of completed and on-going projects, etc.	Atlantic Projects Company Limited was formerly a wholly owned subsidiary of GE. APCL has been a successful service provider to GE for more than forty years as part of GE and as an independent subcontractor. In this period APCL services included new build and unit overhauls worldwide. Please refer to the execution Strategy file that has been submitted as part of the technical proposal for more details.	Complied and Closed.
5	do ARAFIQ TO	In Sections 4.12.2, 4.13.10, 4.18.6, 4.20.11 & 4.21.5, please confirm that the civil/structural exclusions did not deviate from the original SOW in the bid document.	Confirm	Complied and Closed.







BID COMMENTS / CLARIFICATIONS									
Project: RFP Collective No. YNB-PR6947	Bidder: GE								
GTG 1-8 Rehabilitations (GE PBC-CE-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0								

6	-do-	GE should follow exactly Marafiq stated SOW civil works for any new foundation & concrete repairs. Note: Marafiq SOW documents highlighted that vendor shall follow following Marafiq company procedures. - General specification for civil foundations for equipment - Civil and structural design calculation - Foundation repair work Drawing	Noted as applicable	Complied and Closed.
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Project: RFP Collective No. YNB-PR# 7000006947	Bidder: GE
GTG 1-8 Rehabilitations (GE PBC-ME-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. lo.	Reference in Bid Document	MARAFIQ comments on 30 th June 2015	Bidder's Response on 1st August 2015	MARAFIQ comments on 05 th Aug 2015	Bidder's Response on 20 th August 2015	MARAFIQ comments on 25 th Aug 2015	GE Response 27 th Aug 2015	MARAFIQ comments on 29 th Aug 2015	GE REPSONSE 07SEP2015	MARAFIQ comments on 08 th Sep 2015	GE REPSONSE 13SEP2015	MARAFIQ comments on 16 th Sep 2015	MARAFIQ comments on 02nd Nov 2015
1.	Executive Summary Page 8 - Item #2&3	GE included and listed both Nox Control System for the three options (Only one need to be listed)? We need GE to Specify which system (DLN or Water Injection) is essential and it can be used without any impact on HRSG?	1- For Gas Fuel operation, either option can be used to limit emissions below 80ppm. DLN-1 however can limit emissions below 25ppm. 2- For liquid fuel operation, both options offered in the technical proposal are essential to reduce the emissions below 80ppm. GE will provide Exhaust Profiles to Marafiq for HRSG evaluation at a later stage.	GE Has to be confirming that as per SOW, we have mentioned that the Exhaust Temperature should not reach more than 590 Dec.C. This should be confirmed during the Technical evaluation stage not in later stage, because this will affect our Existing HRSG operations.	Units exhaust shall reach 593C	Not Acceptable, As per SOW the Exhaust Temperature shall be less than 590Dec.C	Bidder Confirms comply to less than 590C Exhaust Temperature	O.K, Closed				O.K, Closed	O.K, Closed
2.	Executive Summary Page 8 - Item #10	More interpretation for the alternative offer Included Partially replacement? What items inside Exhaust Plenum will be replaced?	1- All required parts that have been requested in the proposal for the exhaust will be replaced. What is meant by this statement is that some of these items will be part of the flange-flange pre-assembled in USA. 2- For base scope, Exhaust Plenum, Exhaust Plenum, Exhaust Duct, Silencers and Aft Diffuser are being quoted for replacement with current gas turbine technology hardware. 3- For Flange-Flange alternative offer "1", diffuser is part of the F-F equipment already. All other items mentioned in the base scope are included. Exhaust Stack and Dampers replacement	1.O.K, Noted	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed				O.K, Closed	O.K, Closed O.K, Closed MARAFIO PROCUREMENT & CONTRACTS DEPT





Project: RFP Collective No. YNB-PR# 7000006947

GTG 1-8 Rehabilitations (GE PBC-ME-001)

Bidder: GE

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	are optional as per site visit raised comments.		of the state of the				was a contract			
Executive Summary Page 9 - Item # 25 More clarification is required regarding the merit and un-merit of replacement the Hydrogen Cooled Generator by Air Cooled Generator? Unless commercially is equal or cheaper than rewinding?	- A new generator means a new zeroed running hour counter, thus theoretically your new generator should be working trouble free for 20-30 years Although operation with H2 is a technology widely used and it is well proven within GE, but eliminating the need for H2 by using an air cooled generator will eliminate any running costs related to H2/CO2, also that should simplify the generator associated auxiliaries which will be reflected on operation & maintenance activities Marafiq is already considering replacement of all Hydrogen panels, detectors, HVAC, rewinding of rotors and stators which will be eliminated if a generator replacement is considered. Smaller and brushless exciters will be considered for EX2100e upgrade.	Noted and Closed.	More Details and feasibility Study is required.	For Additional details on the new Generator offer, please refer to proposal sections "4.24 Complete Generator" (page 191 onwards) 4.24 Complete Generator Rep	It is not clear whether GE has studied and confirmed the feasibility of actual installation of the new generator at the existing location of old generator. Also the compatibility with existing equipment, auxiliary requirements, interfacings etc. should be determined, if this option is to be considered. Section 4.24 given by GE in the proposal is very brief and mostly just a general description of construction of generator.	Please refer to the attached summary of what is included in GE scope: 7A6 Gen Summary for MARAFIQ Yanbu	'Ref. 'Uprate Evaluation' Graph in '7A6 Gen Summary' attached by GE: In the graph, at 122 deg.F (50 deg.C), the output is shown as around 62 MW at 0.8 p.f (dotted line), which is an increase from the present base rating. However GE has also mentioned that 'Hitachi Generator must run at 1.0 p.f to accommodat e GT uprate.' So, GE's above-quoted remark seems to contradict with the graph interpretation . GE to clarify this discrepancy and confirm whether the generator is capable of an additional output of 4.4 MW above the current base rating,	The interpretation is incorrect the capability curve at 0.8PF does not meet any of the uprate options requested	. Generator Rewinding out put considerin g the Uprate to be confirmed by GE. . GE was mentioned that '7A6 Gen Summary' document is related to Cooling Water Temperatu re at Site. Please provide the complete details for the same.	O.K, Closed Considering the Rewinding without Power augmentation.



Project: RFP Collective No. YNB-PR# 7000006947	Bidder: GE
GTG 1-8 Rehabilitations (GE PBC-ME-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

									at 0.8 p.f after re-winding, as per the intended outcome of the GT uprate.' #GE was mentioned that '7A6 Gen Summary' document is related to Cooling Water Temperature at Site. Please provide the complete details for the same.		
4.	Additional Equipment Considerations Page 9	More elaboration about the Turbine Compartment Laser Scan to be used for what?	Laser scan is required for rehabilitation of this site in order to get information about the current configuration for the turbine compartment to prevent interferences with components or piping currently installed.	Noted and Closed.	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed		O.K, Closed	O.K, Closed
5.	Additional Equipment Considerations Page 9	included in the Marafiq SOW, also Gas Final Filter is equipped by safety relief valve. The Contractor scope shall include the replacement of existing orifice and obsolete multi variable	SSOV and Coriolis flow meter have been included in the revised technical proposal. Attached drawings contain outlines of the valves that should show more details on the offering. Deviation on the offering is noted and	Noted and Closed.	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed		O.K, Closed	MARAFIQ MARAFIC MARAFI









Project: RFP Collective No. YNB-PR# 7000006947	Bidder: GE
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Additional Equipment Considerations Page 9	assessment will need to take place to identify and address these issues, including the development of new drawings and installation instructions, prior to shipment. These tasks are mentioned here as a reference, but fall outside of the scope of this proposal and would have to be quoted separately. More clarification required for the extensive site Assessment for the mentioned systems and what is your scope for such assessment?	A list of required information has been sent to Marafiq	O.K, Noted	Noted and Closed.	We submitted the Update Excel to M/s	GE Response will be part of ME-004	O.K, Noted	O.K, Noted	O.K, Closed
Hot Gas Path Combustion & Miscellaneous Materials From Page # 14 - 16	Material's Description shall be confirmed by GE from Marafiq Warehouse.	sent to Marariq separately. If Parts Exchange Program is considered, then more details on available parts shall be provided for proper assessment. Please refer to the attachment (GE Parts Exchange Program_PGS Buyback History Information.xlsx) for the required data.			GE for the Detailed response.	IVI E-UU4			Solution States



Project: RFP Collective No. YNB-PR# 7000006947

GTG 1-8 Rehabilitations (GE PBC-ME-001)

Bidder: GE

Bidder: SRef: PROPOSAL # 778781-15-YGTZ Rev.0

4.1 Cooling Water Radiator S Page # 14	Forced-draft air- cooled heat exchanger shall be shipped as a factory- assembled unit complete with fans, motors, and drives. GESOW: Each proposed cooling water module consists of one forced-draft air-cooled heat exchanger, two pump and motor sets. Also, GE to mention if there is another deviation from Marafiq Scope related to Pump & Fan Power supply due to technical data specification is missing? The Scope is generic		O.K, Noted with reference to the attachment, as per Data Sheet (6 No's of Fan x 20% - 5W+1S). In Scope of supply it was mentioned 2 Nos of FD fan, Please confirm which one is correct as well as Please to be confirm the Existing Cooling water module space is sufficient for proposed system also provide the Layout for the same.	Please Refer to ME-002/ME-003 for a more detailed update on this point.	1. As per SOW We were asked for Each Module has 3 Nos of FD fan (2 W+1S), But GE Proposed one module no redundancy and other module has 1 no of FD fan as redundancy. Please clarify the same. As well as we asked the confirmation about bidder for adequacy of space to accommodat e the Proposed Cooling water module. Please confirm the same.	design, 5 out of the 6 fans are operational and the 6th is on standby, the 6th fan will redundant per module. Each module is capable of cooling 1,200 gpm of 20% Ethylene Glycol / 80% Water from 172.79°F to 148°F while rejecting 14,200,000 BTU/hr at an ambient of 140°F. (Same Clarification as in ME—003)	O.K, Noted Technically acceptable However your team has taken Measurement for accommodating the Proposed Cooling water module in the existing available space. Please confirm the same. Hence our Existing Cooling water module Over all Foot print size 10320mm x 5600 mm. Please provide the details without disturbing the Generator Access road and others. Please find attached drawing for your reference.	The Proposed Cooling Water Module can be rearranged to ~5000mm x 40000mm footprint. Please note the reduction of cooling water module is not possible due to the requested performance. GE proposes to have an additional discussion on the footprint and packaging as needed.	O.K, Noted, However the GE has to plan with the limited space only, otherwise GE has consider the alternate suitable location to accommodat e the same .(Eg: Front side of the GTG Building)	Noted, GE will plan with the limited space only or consider the alternate suitable location GE proposes to have an additional discussion on the footprint and packaging as needed.	O.K, Closed	O.K, Closed
4.2 Nox Control System – Water Injer	and not meeting Marafiq Scope, also nothing mentioned regarding what is the granted reduction level of Nox The Nox? test result must be	included in technical proposal about the performance benefits. About NOx level the values will meet with the customer requirements.	- CTANOLITES CONTROLLED	Closed.	confirm the Nox Reduction of 42 PPM consideration of Water Injection with	control emissions on liquid fuel (for both DLN and standard combustion) will be 80ppm						OLLI DELLASCE









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		compliance with RC limit at the worst case Also, What is the power output will be gained after using Water injection system?	Need confirmation of the customer emission limits that are required, World Bank vs the <80ppm NOx.			reference to the Clarification GE-PBC –ME- 002.	or below, water injection is needed. For DLN dry gas operated units, 25ppm can be reached. With water injection for standard combustion the limit on gas will be 42ppm. (as clarified in ME-002)			
0.	4.2 Nox Control System – Water Injection	GE shall provide the Centralized Water injection package to satisfy the demand of supply to GTG-1-8 simultaneously and this package shall include the Storage and Distribution. The Demineralized water input shall be taken from the STG 1-4 & 5-6 Storage and Distribution network. This unit shall locate outside the GTG building. The system not included in GE Scope.	not an option that GE provides as a standard. The proposal includes a Water Injection system per unit GE has noted the limitation on the space and will provide skids that can fit in the designated area.	O.K, Noted, However as per SOW DM water transfer and storage system is required, Please confirm the same.	DM tanks and forwarding skids shall be provided with individual injections skids at each unit.	Bidder shall confirm as per SOW, we are indicated that DM Water Transfer Pump from STG-5 &6 and Transfer line to the DM Water Storage tank and Cathodic Production for the Tank Foundation Pad and DM water distribution pump with transfer pipe line.	Compliance to SOW confirmed, including Cathodic Protection. Additional Details will be provided after contract award.	O.K, Closed	O.K, Closed	O.K, Closed
1.	4.2 Nox Control System – Water Injection	GE shall integrate the Mk VIe Water Injection Control System with ABB supplied DCS/UCS.	Confirm	O.K, Closed	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed
)	4.3 Nox Control System – DLN	The Scope is generic and nothing mentioned about acceptance criteria limits for DLN System on both fuel Sales Gas and LFO?	The maximum NOx emissions levels are according to the customer requirement: 80 NOx PPM for both Gas and for Liquid. A combustion analysis is performed to guarantee that the emission values can obtain to guarantee them.	O.K, Noted	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed









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13.	4.3.3 Nox Control System – DLN – Page 28	In GE Scope the high exhaust temperature (1100 F) is a design point that an existing HRSG should be verified as capable of accepting. While the HRSG Max. Design Temperature is 577 C. Please verify and confirm that DLN can be used for the existing HRSG?	Yes the DLN can be used with the existing HRSG. The exhaust profile is a function of the Tfire unit. For performance numbers provided, the F2F isotherm must be increased to 1100°F (Std or DLN1). For full upgrade 1035°F is enough. The HRSG specification must be reviewed to confirm that it will be capable for the isotherm increase GE will provide Exhaust Profiles to customer for HRSG evaluation with HRSG vendor.	O.K, Noted	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed
14.	4.3.5 Nox Control System – DLN – Page 29 – Item (2)	In GE Scope (2) Fuel Composition. The fuel gas for DLN is required to be a natural gas that conforms to the requirements of the latest edition of GE fuel specification GEI 41040. The existing gas is Sales gas which is different than natural gas, GE to confirm that Sales Gas is acceptable to be used with DLN.	The Natural Gas specification must comply with the GE Fuel Spec	confirm that our sale gas specification meet out the GE requirement	specs used for this proposal are the one from the RFQ as attached and this is in compliance with GE specs, however, customer has to make sure that gas specs are always complying to GE standards.		Closed.			
15.	4.3.5 Nox Control System – DLN – Page 29 – Item (2)	In GE Scope The customer has already provide the follow fuel specifications for Natural Gas Marafiq submitted Sales Gas Specifications and existing units firing sales gas not natural gas, may the attached with GE Scope is old specification data.	The Natural Gas specification must comply with the GE Fuel Spec attached in item 14 above. GE will have to rerun the calculation with the new gas composition being referenced.	Bidder has to confirm that our sale gas specification meet out the GE requirement.	The gas fuel specs used for this proposal are the one from the RFQ as attached and this is in compliance with GE specs, however, customer has to make sure that gas	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed









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					specs are always complying to GE standards.					
6.	4.3.7 FK3YC - Aspirated Infrared (IR) Hazardous Gas Protection System-Page 31	The number of IRs required to be installed for each area (Gas Valve, Turbine Compartment & Ventilation Exhaust Duct need to be mentioned.	The IR's quoted are a standard quantity and are 2 for the Gas Valve and 2 in the turbine compartment. The CFD will determine if additional will be required. IR haz gas protection is not required in the exhaust duct.	O.K, Noted	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed
7.	4.5 Compressor Assembly & un-bucketed Turbine Rotors Replacement	GE to provide a detailed Scope regarding compressor / turbine rotor specifications and disassemble of old rotor / assemble of the new rotor.	More details will be provided in the revised technical proposal.	O.K, Noted, when will be the revised proposal to be submitted.	Un-Bucketed Turbine and Compressor Rot	O.K, Noted, Bidder indicated that Appendix 2 TIL 1562 and TIL 1576, No attachment and details for the same.	Noted, TILs added: t1562r1.pdf t1576r1.pdf	O.K, Closed.	O.K, Closed	O.K, Closed
3.	4.7.16 Oil Mist Eliminator Replacement	The mentioned GE Scope for this item need to be removed. Marafiq SOW not includes Oil Mist Eliminator Replacement.	This was included as optional only. New Oil Mist Eliminator is not a requirement for the modifications offered	O.K, Noted	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed
9.	4.10 Replacement of Exhaust Plenum for GTG Units Page 92	GE Scope will provide an internally "floating" liner system.	Please refer to the below attachment. More details will be provided in the revised technical proposal.	O.K, Closed	Noted and Closed.	O.K, Noted, Bidder not Submitted revised Proposal	Please refer to additional details in GER4610, Exhaust System Upgrade Options for Heavy Duty Gas Turbines. Figure 11; "CHROEM floating liner plenum and exhaust frame with aft diffuser" has detailed	O.K, Closed	O.K, Closed	O.K, Closed





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						description of "floating" liner system. GER4610 Exhaust System Upgrade 05-			
4.10 Replacement of Exhaust Plenum for GTG Units Page 92	exist in walls". Please Provide the technical Data specifications for the insulation.	The Chroem specifications is included as attachment above	O.K, Closed	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed
4.10 Replacement Exhaust Aft Diffuser Units Page 93	GE Scope mentioned "This new design applies to 7EA models since they have the unique "flat plate" diffuser design when compared to the rest of the product range that use "pipes". Is the Exhaust Aft Diffuser can be fit without major modification for the existing GTG Units frame 7E?	Diffuser replacement was considered according to the current configuration; therefore, the new design will fit with the current installed	O.K, Closed	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed
4.23 Flange to Flange	This option need to	This is optional offering. F-F offering is a pre engineering solution that is designed to fit existing 7E units foundation and configuration with minor site work. Since replacement of major parts of the gas turbines has already been considered by Marafiq in this project, this option covers all of the items inside the turbine and comes factory-assembled and tested with zero running hours of all parts (IGVs,	O.K, Noted	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed O.K, Closed

2.0



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<i>-</i>					_		+	4	-	
			compressor rotor, stators and blades, combustion parts, HGP parts, turbine rotor, exhaust frame, casing, bearings).							
23.	4.24 Complete Generator replacement with Air cooled 7A6 Type	Do the new generator can be fitted on the same foundation of hydrogen cooled generator or required a new foundation? Consider the existing area is small and congested!!	generator. GE selected EPC is well experienced in such work. Site visit has already been conducted and all related information have	O.K, Noted	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed
24.	Performance Testing Training Page 231	Comprehensive course is required to be designed to cover Theoretical and Practical training course. 3 days are not enough to cover such course to develop GT Performance Engineer.	A revised training curriculum for performance engineer will be sent as part of the revised technical proposal.	O.K, Noted, When will the scheduled date of submission of revised technical Proposal.	Attached is the proposed training program for a performance engineer Performance Engineer Training	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed
25.	4.25.11 Performance Testing Training	1.) The performance test must meet the required as mentioned in the SOW in the performance test and training section and it should cover all the requirement of it. 2.) The performance test training must be ahead of project execution in order to train the process Engineers and make them full acknowledge. 3.) GE has to provide the period of training as mentioned in the SOW. 4.) GE has to give practical and theoretical training for process Engineers.	for each line item will be provided to Marafiq along with the revised technical proposal. 2- Ok 3- Ge will provide the revised training program for Marafiq	O.K, Noted, Please confirm the Date of Revised Technical Proposal.	1- Kindly find it attached. 2- Ok 3- Same as 24 4- Same as 24 Compliance Sheet	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	O.K, Closed









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Bidder: GE

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Reference in Bid Document	MARAFIQ comments on 30 th June 2015	Bidder's Response 1st August 2015	MARAFIQ comments on 5 th August 2015	Bidder's Response on 20 th August 2015	MARAFIQ comments on 23 rd August 2015	GE Response 27 th Aug 2015	MARAFIQ comments on 29 th August 2015	GE Response 07SEP201 5	MARAFIQ comments on 8 th Sep 2015	GE REPSONSE 13SEP2015	MARAFIQ comments on 16 th Sep 2015	MARAFIQ comments or 02nd Nov 2015
	1.1 Is the cooling water module will be tested to confirm the current site conditions in the summer time, when the ambient temperature is between 50°C to 60°C, confirming that no any spraying water future with normal turbine lube oil & generator H2 cold gas temperatures with MAX unit load.	No spray is expected for cooling water module.	O.K Noted, However bidder should confirm that water spraying arrangement provided or not, Hence in Clarrification#3 Mentioned Spray provided for fins cooling.	Confirmed, No water spraying should be required for the cooling system and the system shall meet the data sheet description.	O.K, Closed	Noted and Closed.	O.K, Closed					
4.1 Cooling System Radiator Skids	1.2 To give us how much lube oil temperature will be maintain by New radiator cooling skids with ambient temperature in between 50°C to 60°C during summer time.	For cooling water 142 deg F, the expected lube oil temperature in the tank is 160 deg F max	O.K, Noted, Please provide the lube oil HDR temperature.	The cooling water exit temperature @ 160F shall be 148F while the lube oil tank temperature shall be 160F, oil HDR temp shall be in between	O.K, Closed	Noted and Closed.	O.K, Closed					
	1.3 Is cooling RAD finned tubes bundle will be safe from weather conditions exposure, please explain.	conditions mentioned in the	O.K, Noted	Noted and Closed.	O.K, Closed	Noted and Closed.	O.K, Closed					
	1.4 Clarify the numbers of fans and operations criteria	It will be a 14 diameter forced draft per bay, therefore 2 forced drafts per module. The Marafiq has asked for redundant fan motors, and GE is going to provide that. Confirmed number will be defined after design reviews	O.K, Noted, The bidder has to confirm the Redundant fan will be provided as per SOW.	There will be 2 redundant fan motors per fan bay. There will be 12 redundant motors for the whole project.	Please Clarify as per your submittal. GE Proposed one module no redundancy and one module has 1 no of FD fan as redundancy, against that only 8 Nos FD	As per the design, 5 out of the 6 fans are operational and the 6th is on standby, the 6th fan will redundant per module. Each module is capable of cooling 1,200 gpm of 20% Ethylene Glycol / 80% Water from 172.79°F to	O.K, Noted					120-4/0









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		which occur after the PO.			fan Redundant you indicated that 12 Nos of Redundant fan.	148°F while rejecting 14,200,000 BTU/hr at an ambient of 140°F.					
	1.5 To make heat balance for all coolers by New RAD cooling skids with several loads.		O.K, Noted	Noted and Closed.	O.K, Closed		O.K, Closed				
42 Nox Control	2.1 Explain the water injection system deficiency? Mention the ratio of the Nox reduction.	It will depend on fuel conditions and field conditions. Preliminary water schedule was provided already in the proposal at certain cases, 3 points For DLN Gas fuel operation, no water needed. For liquid fuel operation, water injection will be needed for NOx in both cases.	O.K, Noted, We have already given our Fuel specification sheet for technical confirmation from GE. Bidder has to be confirm that DLN required water during start up (Liquid Fuel).	No water injection on liquid is required during start up.	O.K, Closed		O.K, Closed				
System Water Injection	2.2 If an increase in Power is generator capacity could be met. Write on details.	A generator analysis must be performed. GE has not yet received a critical curve that would allow GE to complete a thorough generator capability. Marafiq may need to interface with generator manufacturer (Hitachi)	We already submitted the Generator Capability Curve for the Analysis	With data fimitations and at one temperature point, capability study indicated that current generators will not be capable to the uprated GT's or F2F without a big change in pf, probably unity.	Please clarify that Generator Rewinding can be in the SOW, So, GE has to confirm that Power Increases suitability of Generator after rewinding.	Rewinding the generators will not yield a sufficient increase in generator capability to fully benefit the gas turbine uprates without changing pf to unity.		'Ref. 'Uprate Evaluation' Graph in '7A6 Gen Summary' attached by GE: In the graph, at 122 deg.F (50 deg.C), the output is shown as around 62 MW at 0.8 p.f (dotted line), which is an increase from the present base rating.	The interpretation is incorrect the capability curve at 0.8PF does not meet any of the uprate options requested	1. Generator Rewinding out put considerin g the Uprate to be confirmed by GE. 2. GE was mentioned that '7A6 Gen Summary' document is related to Cooling Water Temperat	O.K, Closed, Considering the Rewinding without Power augmentation







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2.3 Whice components will be affect by Water injection and time	not affect	O.K, Noted	Noted and Closed.	O.K, Closed	O.K, Closed	same.	اء والمياه لا
						document is related to Cooling Water Temperature at Site. Please provide the complete details for the	
						#GE was mentioned that '7A6 Gen Summary'	
						per the intended outcome of the GT uprate.'	
						current base rating, at 0.8 p.f after re- winding, as	
						capable of an additional output of 4.4 MW above the	
						this discrepancy and confirm whether the generator is	
						with the graph interpretation. GE to clarify	
						So, GE's above-quoted remark seems to contradict	
						must run at 1.0 p.f to accommodate GT uprate.'	details for the same.
						mentioned that 'Hitachi Generator	provide the complete
						However GE has also	Site. Please







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being for replacement?	injection Maintenance factors to be specified per GER 3620M (Sent as part of the Marafiq POST BID clarification (GE PBC-ME- 003_R1_GE). Actual maintenance factors will depend on combustion analysis, which will take place during design phase.					
2.4 Is water injection system control will depend only for fuel analysis or related to actual Nox readings		O.K, Noted, Bidder should reply according to fuel analysis provided by Marafiq (ARAMCO Fuel analysis)	To control emissions on liquid fuel (for both DLN and standard combustion) will be 80ppm or below, water injection is needed. For DLN dry gas operated units, 25ppm can be reached. With water injection for standard combustion the limit on gas will be 42ppm.	O.K, Closed	O.K, Closed	
2.5 Is Contractor confirmed the water quality requirements meets the standard.	Water specs must be as per the attached GEK101944.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	
2.6 GE to provide all equipment control specifications & diagrams.	Will provide final manuals with equipment design. We may provide the water injection schedule after it has been designed.	O.K, Noted	Noted and Closed.	O.K, Closed	O.K, Closed	
2.7 Which GE prefers to safe components from damage, water injection or DLN; explain with required details.	DLN operation, by virtue of not using water or steam, does not affect components. Water injection Maintenance factors to be specified per	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	MARAFIQ W









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		GER 3620M. Actual maintenance factors will depend on combustion analysis, which will take place during design phase.								
	3.1 Is existing Gas stop ratio control valves will be on DLN firing system or new will be installed?	New valves will be provided with DLN configuration	O.K, Closed	Noted and Closed.	O.K, Closed		O.K, Closed			
	3.2 Confirm the primary fuel nozzles not affected during premixed operation.		O.K, Closed	Noted and Closed.	O.K, Closed		O.K, Closed			
	3.3 Confirm If Nox control system DLN will be efficient with existing IGV or required for replacement.	Existing IGV's have different profile than new ones, so performance will not be as good as with the new ones. DLN operation is still possible, perhaps under different liner tuning.	O.K, Closed	Noted and Closed.	O.K, Closed		O.K, Closed			
I.3 Nox Control System DLN	3.4 How much MW loss by DLN system during hot season or load capacity will be the same, which meant by less efficient?	More details will be shown in the revised	Bidders please confirm when we will get the revised proposal.	Kindly Find attached. Performance Analysis	O.K, Closed		O.K, Closed			
	3.5To confirm HI exhaust temperature will not affecting HRSG; explain and give more details.	GE will not be able to evaluate impact. GE is providing Exh profile to Marafiq for evaluation.	Bidder has to confirm as per SOW the Exhaust temperature should be less than 590 dec.C	Exhaust temp shall be 593C for the uprated units and/or F2F. Customer has to account for the temp drop in the piping between the exhaust stack and the HRSG.	Not Acceptable, As per SOW the Exhaust Temperature shall be less than 590Dec.C	Please Refer to Item 1 in ME-001 for the details about impacts of limiting to lower firing temperature	O.K, Closed			
	3.6 Which is meant by your written on 4.3.4 page 29 (if Nox are to be reduced in the diffusion flame when	For liquid fuel operation, water injection is required to meet emissions.	Bidder should confirm that If DLN is installation also required water	To meet emissions on liquid fuel with DLN, water injection is needed.	With reference to the Clarification GE-PBC-ME- 001, not Required	Water is not needed during start up on Liquid Fuel with DLN system.	O.K, Closed		عادماي	lige









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V	ourning liquid fuel, a water injection system is required.		injection provision.	To meet emissions on gas with DLN, no water injection is needed.	water for the DLN during start up Liquid Fuel. Please confirm the same				
t t	3.7To confirm the result of Nox % will be controllable if Aramco Fuel Composition change.	If fuel composition change from within bounds per GE specification, then yes; although retune may be required.	O.K, Noted	Noted and Closed.	O.K, Closed		O.K, Closed		
3 A a s	3.8 To confirm if Aramco Sales Gas and LFO Fuel specifications meet the requirement of GE.	Please check the GEI-41047, and GEI 41040	Bidder has to be confirm the specification is meet out the GE requirement's or not.	specs used for this proposal are	The Detailed Gas fuel specification will be provided to GE as early as possible.	Noted			
1 1 0	3.9 To confirm the location of Gas fuel valves enclosures for DLN system if will be on Turbine compartment or outside.	GasValve skid will be located outside the turbine enclosure	O.K, Closed	Noted and Closed.	O.K, Closed		O.K, Closed		MARAFIO L









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	3.10 Please make comparison between both Nox Control systems.	More details will be provided in the revised proposal	OK but Bidder please to confirm when we will get the revised proposal.	GER3568G explains in details both systems GER3568G	O.K, Closed		O.K, Closed					
4.5 Compress or Assembly & Un-	4.1 Is old Rotor shaft can be Rehabilitated or must be replaced by New?	The scope of GE offering does not include Life Extension to the existing rotors. Please advise this comment?	O.K, Noted, Shaft to be replaced by new one.	Closed	O.K, Closed		O.K, Closed					
bucketed Turbine Rotors Replacem ent	4.2 Which of the total running hours of Rotor's if used water injection and DLN Nox Control	Please Check the GER-3620M. It Will have to calculate the MF based on water consumption.	Provide GER3620M	Was sent as part of the previous clarifications. Closed	O.K, Closed		O.K, Closed					
4.6 Extender parts for Hot Gas	5.1To specify and confirm the Maintenance cycle when using DLN & Water Injection System.	Please Check the GER-3620M Will have to calculate the MF based on water consumption.	Provide GER3620M	Was sent as part of the previous clarifications. Closed	O.K, Noted, However the Bidder shall to confirm the Maintenance factor against our submittal. Hence there should not be any Ambiguity for calculated number, this may GE claim the Subject to conditions clause.	Please refer to Appendix A from ME-003 detailing Maintenance Factor: GE PBC-ME-003_Append	O.K, Closed					
path	5.2 Which the replacement intervals of new combustion components for 32 K	Standard: 160,000FFH/4,500F FS DLN1: 160,000FFH/6,500F FS Replacement is 160K interval Inspection interval is 32K interval	OK noted	Noted and Closed.	O.K, Closed		O.K, Closed					
4.7 Full unit Uprates of GTG	explain as per your mentioned uprate	A table for all these parts with expected affect is added to the revised technical proposal.	Bidder please confirm when we will get the revised proposal.	Kindly Find attached.	O.K, Noted, We have asked bidder to provide Each component	Please find attached the Performance Estimates:	O.K, Noted, GE clarify that on 20 th submittal Provided performance	Please see attached document replacing previously sent	OK , Noted but please GE has to confirm that MAX Guarantee unit load and	Final Guarantees will be part of the commercial offer.	O.K, Noted	ع والمياه برايد MARAFIQ المعتبر المترد المت





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increased reliability and availability and reduced maintenance intervals, please provide more details			Uprated Parts	Uprate the Increase output and reduced Heat rate in Table. Please provide the Same.	GE PBC-ME-002_6.2 Perfrormance Effect. (Changes may be applicable due to the change from 593C Exhaust Temperature to 590C)	effect of 11%, 9.2% and 9.5%. In 27th submittal overall Performance effect is 13.66% increased output and reduced heat rate of -4.19%.	consider configuratio n for pre and post uprate, DLN/non DLN etc.	total efficiency % must at this load. Also GE has to confirm that the Performance effect was considered at the Exhaust Temperature less than 590 Dec.C	Confirmed, 590C Exhaust Temperature considered.		
6.2 Is uprate system will increase more load then required of new Generators ratings to meet the new capabilities.	Generator Capability must be evaluated. We have not yet received a critical curve that would allow GE to complete a thorough generator capability. Marafiq may need to interface with generator manufacturer	We already submitted the Generator Capability Curve for the Analysis	Please refer to point 2.2	Please clarify that Generator Rewinding can be in the SOW, So, GE has to confirm that Power increases suitability of Generator after rewinding.	Rewinding the generators will not yield a sufficient increase in generator capability to fully benefit the gas turbine uprates without changing pf, probably unity.			Same as SI.No:2,Clause 4.2		Same as Si.No:2,Clause 4.2	O.K, Closed, Considering the Rewinding without Power augmentation.
6.3 Explain more details regarding mentioned on page 68 for (GE cannot guarantee performance, if the stage One (1) nozzle use in the uprate was repaired by a third party, so please which meant exactly by last statement.	All components must be provided by GE, if S1N is provided, repaired or modified or a different that GE performance benefits will not be guaranteed	Bidder should understand this as EPC package, as per the SOW the Bidder responsible for Performance guarantee.	If all the parts are OEM, then there are no issues with the performance increase as long as they meet the criteria mentioned in the proposal for 2055F capability.	O.K, Closed		O.K, Closed					
6.4 Can modify IGV hydraulic piping & operating actuator to be installed outside Turbine & compartment to easy maintenance and safe unit during oil leaks.	Needs evaluation, but would be a custom design and additional cost.	O.K. Noted	Noted and Closed.	O.K, Closed		O.K, Closed					
6.5 Which the last benefits of Nimonic	Noted, more information is added	Bidder please confirm when we will get the	Please refer to point 6.1 above.	O.K, Closed		O.K, Closed					MARAFIQ" Mer







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1	Transition pieces ;	in the revised	revised				
	more details required	technical proposal.	proposal.				
	6.6 By new parts to be replaced on uprate (will allow for operation at the higher firing temperature) as mentioned, please which the benefits of operation at the higher firing temperature: Is this	gas turbine to be both more powerful and efficient, by design (Brayton Cycle). It serves a similar purpose as that of increasing the stroke in a car engine, but in a different engine cycle. To uprate to 2055°F, some parts	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	
	6.7 As said on 4.17.13 the airfoil will reduce stage losses and improve stage efficiency, will be this to increase unit capacity.	Yes, performance benefits in output and heat rate will be obtained	O.K, Noted	Noted and Closed.	O.K, Closed	O.K, Closed	
	6.8 Why mentioned	Standard control curve is different than the uprated parts control curve. However, this will be done by GE as part of the project for the uprate purposes.	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	
	6.9 Why mentioned on 4.7.16 oil mist eliminator replacement, is existing system not sufficient and required for replacement.	Oil Mist Eliminator has been included as optional replacement	O.K, Closed	Noted and Closed.	O.K, Closed	O.K, Closed	
4.8 Rewindin g of Generator Starter & Rotor	7.1Is RTD to be replaced during Generator Rewinding.	this is not required.	O.K, Noted	Noted and Closed.	O.K, Closed	O.K, Closed	MARAFIQ" AC
1		TO THE WHEN	200		Page 9 of 12		PROVIDENCE!





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Project: RFP Collective No. YNB-PR7000006947 Bidder: GE

lader: GE

GTG 1-8 Rehabilitations (GE PBC-ME-002)

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	4.10 Replacem	8.1 As we suffered from a lot of damage for exhaust duct liners, it must be utilize new installed materials not to damage frequently, did you have study the reason of damage existing parts?	Is this is referring to the internal insulation panels in the exhaust plenum, by virtue of the environment in which they operate, those have a life expectancy that is shorter than that of the turbine itself. However, the new plenums come with a more durable design.	O.K, Noted	Noted and Closed.	O.K, Closed		O.K, Closed		
	ent of Exhaust Plenum for GTG Units	8.2 We have a several times, BRG # 3 VIB prope damaged and replaced, how can we prevent this frequent damage by heat; Please include the way of that with New replacement of exhaust plenum & diffuser.	The exhaust frame cooling that provides cooling air to the #3 bearing area is being upgraded to current type blowers, 125 hp each that will operate together to provide the required cooling flow to the new exhaust frame and bearing tunnel area. More details for the new cooling blowers have been added in the revised Technical proposal will have.	Bidder please confirm when we will get the revised proposal.	Details was provided as part of clarification number PBC—ME-GE-001 R1, item 19. Please advise if further details are required.	Bidder not Submitted Revised Proposal	Please refer to GER4610 which has detailed description and additional visual information in figure 15/16 for benefits on the cooling if bearing #3 area. (already attached in ME-001, item 19)	O.K, Closed		
9	4.23 Flange to Flange	9.1 Is the condition of units are required to flange to Flange, please explain	This is optional offering. F-F offering is a pre engineering solution that is designed to fit existing 7E units foundation and configuration with minor site work. Since replacement of major parts of the gas turbines has already been considered by Marafiq in this project, this option covers all of the items inside the turbine and comes factory-assembled and tested with zere	O.K, Noted	Noted and Closed.	O.K, Closed		O.K, Closed		MARAFIQ" ME









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GTG 1-8 Rehabilitations (GE PBC-ME-002)

Bidder: GE

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		running hours of all parts (IGVs, compressor rotor, stators and blades, combustion parts, HGP parts, turbine rotor, exhaust frame, casing, bearings).								
	10.1 To clarify the GE Grantee to replace the generator with air- cooled for long duty operation. As we have experience with GTG # 9, Generator has been rewind after only Nine (9) Years operation also mostly RTD have failed.	This should be an odd case, we can confirm on this point by even comparing to other fleet (where around 100x 7A6	GE has the information, Hence the GE was performed RLA and generator was rewind again by GE.	New Generators should not have such issues. RCA of GTG9 should support in resolving any possible causes prior manufacturing (if any). Witness test shall be arranged for Marafiq to attend the first unit testing if needed.	We would like to communicate that RCA is available with GE, Hence GTG-9 Studies and rewinding was completed by GE.	Confirmed – RCA available	O.K, Closed			
4.24 Complete Generator replaceme nt with air cool 7AG type" Similar to GTG9"	10.2 IS GE have study the cause of GTG # 9 generator rewinding after short time operation and will have different design grantee will not be affect same occurred on GTG-9.	7A6 generators are the standard GE offering in all new 7E/EA and have proven to be successful fit. Continued upgrades and development are implemented in any new generator and such incident should not be the norm.	However, bidder should confirm the offering with last technology and air-cooling &filtration package more reliable.	Confirmed	O.K, Closed		O.K, Closed			
	10.3 How we can save RTD from failure with air-cooled generators it happened on GTG # 9, which needs for replacement RTD now by STATOR rewinding.	Usually we have redundant RTDs, we can check with the 7A6 manufacturer the possibility of installing additional RTDs which will be mostly a special request with extra cost.	However, bidder should confirm the offering with last technology and air-cooling &filtration package more reliable.	Confirmed	O.K, Closed		O.K, Closed			
	10.4 Is excitation hardware will be compatible with new generator or required for replacement	based on Marafiq decision on either new generator or rewinding, Two different prices will	OK Noted.	Noted and Closed.	O.K, Closed		O.K, Closed		Julo Lulig	2









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GTG 1-8 Rehabilitations (GE PBC-ME-002)

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		be offered to Marafiq.					
	10.5 Is new air cooled generator will keep same turning gear, cranking motor and starting means same or should be changed due new generation will be more heavy and big size.	will be installed in the accessories compartment similar to the one installed	O.K, Noted.	Noted and Closed.	O.K, Closed	O.K, Closed	
4.25 Training	Can you send all training materials for review	Please see the attachment	O.K, Noted	Noted and Closed.	O.K, Noted	O.K, Closed	
	Why is required	EX2100 training will be removed from the offering. Training for EX2100e should be enough to cover all related operation and maintenance needed by Marafiq for the installed system.	O.K, Noted.	Noted and Closed.	O.K, Closed	O.K, Closed	







Bidder: GE Project: RFP Collective No. PR# 7000006947

GTG 1-8 Rehabilitations (GE PBC-ME-003)

Bidder's Ref: PROPOSAL #778781-15-YGTZ Rev.0

Reference in Bid Document	MARAFIQ comments on 30 th June 2015	Bidder's Response on 1st August 2015	MARAFIQ comments on 9 th August 2015	Bidder's Response on 27th August 2015	MARAFIQ comments on 29 th August 2015	GE REPSONSE 08SEP2015	MARAFIQ comments on 9th September 2015	GE Response 13SEP2015	MARAFIQ comments on 16 th September 2015	MARAFIQ commer 02nd Nov 2015
	GE confirm that the cooling water radiator design must be in easy and effective cleaning of fins tube.	New radiator will not require water spray for additional cooling. This will keep the fins cleaner.	O.K, Noted, Please confirm the same.	Confirmed, No water spraying should be required for the cooling system and the system shall meet the data sheet description.	O.K, Closed					
	GE proposal is not clear and also not matching with Marafiq scope of work. As per Marafiq scope, each air cooled heat exchanger shall consists of three (3) (2 duty +1Stand by) forced draft fans. While in GE proposal (4x33%) 12-foot diameter forced draft fans	Cooling water module is being designed to meet the conditions requested by the customer. See cooling water datasheet from vendor.	O.K, Noted with reference to the attachment, as per Data Sheet (6 No's of Fan x 20% - 5W+1S). In Scope of supply it was mentioned 2 Nos of FD fan, Please confirm which one is correct as well as Please to be confirm the Existing Cooling water module space is sufficient for proposed system also provide the Layout for the same.	As per the design, 5 out of the 6 fans are operational and the 6th is on standby, the 6th fan will redundant per module. Each module is capable of cooling 1,200 gpm of 20% Ethylene Glycol / 80% Water from 172.79°F to 148°F while rejecting 14,200,000 BTU/hr at an ambient of 140°F	O.K, Noted					
4.1 Cooling water Radiator Skids	The new design of cooling water radiator is capable of providing the at least 120% of needed cooling for ambient temperature up to 60 degree at full load	See manufacturer sheet	O.K, Noted, the proposed system meet out 106 % at 60 Dec.C.	Running the 6th fan will add 20% to the cooling capacity of the module however, temperature control will limit the oil temperature from dropping below the set point	O.K, Closed					
	Please clarify either one cooling water pump is stand by or both will be in operation during running of gas turbine, as it is not clear in the proposal	See manufacturer sheet	No details in Manufacture Data sheet.	Confirmed, one cooling water pump is standby	O.K, Closed					
	The following Details of the SOW is missing by GE Proposal 1. The Supply & Installation of filling facility for Glycol 2. Sampling Provision for Inlet and outlet of cooling water lines 3. Cold insulation and cladding for supply line	See manufacturer sheet	Bidder has to be respond for clarification which was send by us, No details what we expected from the bidder.	1-GE understands that Marafiq wants a Glycol manufacturing facility; however, the glycol mix is designed to run for a fairly extended period of time before flushing the system and replacing the mix. GE does not believe this will be an economic option if Marafiq	1. GE should confirm the compliance of SOW. the SOW has the Glycol dosing is required for the Cooling water module.	1. GE will comply 2. Closed 3. GE will comply 4. GE will comply 5. GE will comply 6. GE will comply 7. GE will comply to SOW and Marafiq Specs 8. GE will comply	O.K, Closed			MARAFIQ TO MARAFIQUE TO MARAFI







Bidder: GE Project: RFP Collective No. PR# 7000006947 GTG 1-8 Rehabilitations (GE PBC-ME-003) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

Reference in Bid Document	MARAFIQ comments on 30th June 2015	Bidder's Response on 1 st August 2015	MARAFIQ comments on 9 th August 2015	Bidder's Response on 27th August 2015	MARAFIQ comments on 29th August 2015	GE REPSONSE 08SEP2015	MARAFIQ comments on 9th September 2015	GE Response 13SEP2015	MARAFIQ comments on 16 th September 2015	MARAFIQ commer 02nd Nov 2015
	 Pump Material of construction (MOC) to be defined mentioned as shaft MOC Finned tube bundle tube Thickness as 0.06" instead of 0.0787" Header Box corrosion allowance details is missing No details about the Piping material Specification (PMS) Radiator Shed details not provided 			chooses to implement it. 2-The strainer blowdown valve can be used as a sampling point (see attached picture in Appendix C) 3-GE does not believe insulation is needed since the temperature difference and the heat dissipating surface is not going to affect the incoming or outgoing temperature. Such insulation is done when piping are subjected to extreme temperature difference and long runs.	2. O.K, Closed 3. This was agreed by your team during site visit also this information as per SOW. So, GE has to be confirm the compliance or not.					
				4- Ductile Iron Casing, 316SS impeller, Teflon O-ring, 316 SST shaft and sleeve. 5-confirmed 6- The header box includes 1/16" corrosion allowance 7-Bundle tubes will be SA-214 welded carbon steel 8- Confirmed to be provided at the design phase	 O.K., Noted O.K., Closed O.K, Closed We have asked the PMS for the Cooling water piping and fittings. O.K, Closed 					
4.2 Nox	Please provide the maximum quantity of water to be required for each unit for water injection system	Dependent on fuel and Performance will provide fuel to water ratios for operation.	Bidder should understand the comments we already submitted our Sale gas specification, bidder has respond against the Input not generic.	Please refer to appendix A for answering the point	No Attachment	Sent in a separate email	O.K, Closed			
Injection	Please provide the detail of effects of water injection system on the hot gas path components and how much	GER3620M Has equation for maintenance factor on Hot Gas Path and	Detail provided in the GER2620M, but need further engineering study and approval	Please refer to Appendix B in this document	No Attachment	Sent in a separate email	O.K, Closed			JUOLULIS EL







Project: RFP Collective No. PR# 7000006947

GTG 1-8 Rehabilitations (GE PBC-ME-003)

Bidder: GE

Bidder: SRef: PROPOSAL # 778781-15-YGTZ Rev.0

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	time maintenance interval are usually decreased due to water injection system	Combustion with water injection	from TSD to finalized which NOx reduction system is more suitable.							
	Please provide the details about the DM Water Storage ,Supply and Distribution system	More details will be provided after the design phase. Please note that each unit will have a water injection skid controlled by the turbine control panel for each machine.	Bidder has to be confirm as per SOW, DM water incoming from STG (1-6) area to Nearby GTG with transfer pump and piping and Storage and Distribution system to GTG 1-8.	DM water storages will depend on the operating profile along with the type of NOx abatement Marafiq will select to procure.	GE was confirmed the same in GE- PBC-ME-002 _R2, Please clarify	Confirmed GE will supply DM Water Storage and forwarding equipment per SOW.	O.K, Closed			
	Mechanical, Electrical, Civil, Instrumentation & Controls and Cathodic Protection Works details and technical Specification is missing	Intent is to meet Marafiq specifications. If there is any specific details required, please advise	O.K, Noted, However bidder shall submit the Technical specification's which going to be supplied to Marafig.	GER3568G explains in details both systems	O.K, Noted					
	The location of GE Energy Leaning centers and Gas turbine manufacturing and assembling areas are not clear in the proposal	The GE facilities are in Salem, Virginia USA, Houston, Texas USA, Schenectady, New York USA, Belfort, France, and Dammam, Saudi Arabia.	O.K, Noted	Noted and Closed.	O.K, Closed					
	GE to provide technical as well as commercial proposal for carry out inspection on the installed rotor and rotor life extension	This is not part of the SOW. Please advice if this required and we will add accordingly. Also, will this be in a separate line items in the pricing table or how shall it be priced?	O.K, Noted	Noted and Closed.	O.K, Closed					
4.5 Compressor Assembly & Un bucketed Turbine rotors Replacemen t	Please provide the details about the Scope of Supply , Installation , Integration and Commissioning of this units	New rotor similar to what had been supplied to GTG3 back in 2012 and matching the existing installed one in each respective unit will be supplied and installed as part of the major inspection. More details will be provided in the revised technical proposal.	O.K , Noted	Noted and Closed.	O.K, Closed					
	Please provide the details about the Technical specification for the	More details will be provided in the revised technical proposal.	O.K, Noted	Noted and Closed.	O.K, Noted					Jacobulos Maraha .







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Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-ME-003)

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	Compressor Assembly and Un bucketed turbine rotor									
	Please provide the list of components supplied as Extendor parts for Hot path by GE.	No Extendor parts for hot gas path. Only combustion hardware.	O.K, Noted, Please submit the List of components going to be supplied by GE and Which are the component to be used from Our existing stock.	In line with ME-004 this is being reviewed and will be answered in ME-004.	O.K, Noted		O.K, Noted Still GE response is awaited			
	What will be the life of special type of coating (hot gas parts) and if once it is damaged, who will re coat.	Expected life is 32K FFH for Hot Gas Path outage duration. GE certified services shop can re-coat.	O.K, Noted	Noted and Closed.	O.K, Closed					
4.6	This Proposal as a Package no additional Price like Optional items, Please confirm the same.	Marafiq to choose what to price as a package. All optional items have been offered to Marafiq to evaluate what needs to be added and what's not.	O.K, Noted. GE to submit the Optional Items In Extendor Package to Marafiq for Evaluation.	Noted and closed.	O.K, Noted. GE to submit the Optional Items In Extendor Package to Marafiq for Evaluation.	Price for Optional item packages will be detailed in the Commercial Proposal	O.K, Noted			
Extendor Parts for Hot Path	GE has to give the confirmation about capital spares from Marafiq Ware house in the Parts Exchange Programme	A list of requirement has been sent separately. Still waiting for Marafiq reply. See attached excel file named: "GE Parts Exchange Program_PGS Buyback History Information.xlsx"	O.K, Noted	Noted and Closed.	O.K, Noted, We are waiting for GE response.	Ok noted and closed will be sent as part of ME-004	Waiting from GE Response for ME-004		O.K, Closed	
	GE has to give confirmation about the CI for 32K while using the Water injection for Nox Control system.	Depends on Maintenance Factor (example, operating on liquid fuel with water injection on, maintenance factor can be 2.5 which means CI shall be conducted at 12.8k running hours) Maintenance Factor is 1 for DLN operating on gas fuel.	Please clarify the Submitted Technical Proposal mentioned that's Cl 32 K in Extendor (Clause .4.6.2 Page no : 62) with considering water injection.	Please refer to Appendix B in this document.	No Attachment	Sent in a separate email	O.K, Closed			
4.7 Full Unit Up rates for GTG	Detail is missing in the GE proposal regarding the impact on exhaust temperature if the turbine uprate to 2055° F	At Tfire of 2055F, the expected exhaust ISO-therm will be 1100F. Marafiq to evaluate HRSG impact.	Bidder has to confirm as per SOW the Exhaust temperature should be less than 590 dec.C	If exhaust temperature at the stack to be maintained at 590C then firing temperature has to drop slightly; this will impact the performance benefits of the uprate. Marafiq	O.K, Closed		O.K, Noted GE has confirm that is any effect on HRSG, If exhaust temperature of gas turbine is maintained 593° c instead of 590° c, if yes then	Confirmed, 590C Exhaust Temperature considered.	O.K, Closed	والمياه بروسياه بروسياه بروسيات والمقود (ورسيات والمقود (ورسي







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BID COMMENTS / CLARIFICATIONS

Project: RFP Collective No. PR# 7000006947

Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-ME-003)

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				to check if the HRSG limitation is below or at 590C. The temp drop between the stack and the HRSG should be accounted for. If marafiq agrees, we can re-run the performance numbers and change it in the proposal.			what will be the impact on the (uprate) turbine performance if exhaust temperature maintained up to 590° c			
	Please provide the supporting and extensive study document for uprate the gas turbine with respect to the Generator Capability to meet the improvement program.	If Generator capability curves were provided to GE, then study could be done. Only Generator OEM can perform such analysis as this information were not part of the Generator manual nor any data collected.	We already submitted the Generator Capability Curve for the Analysis	Generator capability study indicated that the generator is not suitable unless we increase the PF to almost unity. This will not leave any room to any VAR (reactive power) requirements for the plant.			'Ref. 'Uprate Evaluation' Graph in '7A6 Gen Summary' attached by GE: In the graph, at 122 deg.F (50 deg.C), the output is shown as around 62 MW at 0.8 p.f (dotted line), which is an increase from the present base rating. However GE has also mentioned that 'Hitachi Generator must run at 1.0 p.f to accommodate GT uprate.' So, GE's above- quoted remark seems to contradict with the graph interpretation. GE to clarify this discrepancy and confirm whether the generator is capable of an additional	The interpretation is incorrect the capability curve at 0.8PF does not meet any of the uprate options requested	1. Generator Rewinding out put considerin g the Uprate to be confirmed by GE. 2. GE was mentione d that '7A6 Gen Summary' document is related to Cooling Water Temperat ure at Site. Please provide the complete details for the same.	O.K, Closed, Considering the Rewinding without Power augmentation.

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BID COMMENTS / CLARIFICATIONS

Project: RFP Collective No. PR# 7000006947

Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-ME-003)

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eference in Bid ocument	MARAFIQ comments on 30 th June 2015	Bidder's Response on 1st August 2015	MARAFIQ comments on 9 th August 2015	Bidder's Response on 27 th August 2015	MARAFIQ comments on 29 th August 2015	GE REPSONSE 08SEP2015	MARAFIQ comments on 9th September 2015	GE Response 13SEP2015	MARAFIQ comments on 16th September 2015	MARAFIQ commo 02nd Nov 2015
							output of 4.4 MW above the current base rating, at 0.8 p.f after re-winding, as per the intended outcome of the GT uprate.'			
							#GE was mentioned that '7A6 Gen Summary' document is related to Cooling Water Temperature at Site. Please provide the complete details for the same. We need complete study and confirmation from GE that after rewinding of generators, these generators will be capable to take max load of uprated turbine otherwise uprating of turbine not 100% beneficial			
	Please provide the performance benefits in the terms of reduce heat rates and increased in the output, if unit is uprates with or without replacement of optional components	A table will be added in the revised technical proposal to reflect this.	O.K, Noted	Noted and Closed.	O.K, Closed		to MARAFIQ			
	What will be life of oil mist eliminator filter, if it will replaced as per your proposed new eliminator	This is optional item.	O.K, Noted	Noted and Closed.	O.K, Closed					3 MARAI









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BID COMMENTS / CLARIFICATIONS

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GTG 1-8 Rehabilitations (GE PBC-ME-003)

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	Marafiq purchased hot gas path parts in 2012, are these parts are acceptable for uprates of the system	A full comparison will be provided in the revised technical proposal.	O.K, Noted	Noted and Closed.	Please confirm when GE will be submit the Full comparison.	Will submitted with ME-004	Waiting from GE Response for ME-004		O.K, Closed	
	Clause 4.7.1 Mentioned that Required component GTD - 111 Stage 1 Bucket-12 cooling holes (FS2G) and 4.7.5 GTD -111 Stage bucket -16 cooling holes (FS4A),Please confirm Which	hole bucket will be provided. For existing GTD-111	O.K, Noted	Noted and Closed.	O.K, Closed					
	Clause 4.7.1 Optional Components as mentioned already in the SOW, Please clarify why again this as Optional items.	While interchangeable, these optional parts provide performance enhancements that are shown in performance benefits table in proposal. Marafiq to choose either one of those duplicated (ex. HR-120 Stage 1 Shrouds, Cloth Seals (FS2Y) or Stage 1 Shroud Abradable Coating (FS6A))	O.K, Noted	Noted and Closed.	O.K, Closed					
	mentioned that Improvement Package cannot assured, With reference to the SOW the GTG Rehabilitation as a one package includes of GTG and Related supporting Accessories to improve the rated performance so how can GE will excludes the Performance improvement will not Assured.	is providing all the hardware, there should not be any degrades.	O.K, Noted	Noted and Closed.	O.K, Closed					
	4.7.2 FT5B - C450 Reduce Camber high flow IGV. With reference to the GER-3808C Page no :13 mentioned that Model 71E (Pre-1988) Change in output +1.5%, Change in heat rate - 0.3%, Please confirm the same assured performance	1.5% and -0.3% are estimations. Final numbers are provided in	O.K Noted	Noted and Closed.	O.K, Closed					Control of the contro









BID COMMENTS / CLARIFICATIONS

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GTG 1-8 Rehabilitations (GE PBC-ME-003)

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	improvement with 84 degree IGV angle.									
	4.7.4 FR1D Nimonic Transition Pieces, GE Has to be confirm this component not considered in the Extendor component.	Extendor components include full Nimonic Transition pieces. If customer selects extendor components, then they do not need nimonic transition pieces.	O.K, Noted, Marafiq was asked that in Uprate Proposal GE was mentioned that item No: 4.7.4 FR1D Nimonic Transition Pieces, Please clarify the same.	Case 1: Tfire uprate & Nimonic TPs needed Case 2: extender kit (already include Nimonic TPs)	O.K, Closed					
	4.7.6 FS4B - E Stage 2 Bucket, With reference to the GER-3808C Page no :34 Fig.72 & 73 mentioned that Stage 2 Material IN-738 will suit for up to 1840 °F and GTD-741 Will suit for up to 2055 °F., in the Proposal mentioned that can used at higher firing temperature of 2055 °F. Please confirm the same.	2055F. Proposal will be updated to GTD-741	O.K, Noted	Closed	O.K, Closed					
)	4.7.6 FS4B - E Stage 2 Bucket, As per Present Configuration GTD-741 (10 Cooling Holes) installed Please confirm the same.	confirm	O.K, Closed	Noted and Closed.	O.K, Closed					
	As per SOW Oil mist Eliminator not included, in the Proposal you have included, Please provide justification for the same	This is optional to Marafiq to choose or not.	O.K, Closed	Noted and Closed.	O.K, Closed					
4.11 Replacent of GTG	Please provide the details about the Scope of Supply, Installation, Integration and Commissioning of this units.	The specification is to replace in kind per the customer SOW.	O.K, Noted, Bidder has to submit the Proposed System Technical Information for the Technical Evaluation.	Please refer to GER4610 which addresses the exhaust system upgrade	O.K, Closed					
Exhaust Shut off a By pass damper Geared motor	Please provide the details about the Technical specification for the Exhaust shut off and by pass damper geared motor.	The specification is to replace in kind per the customer SOW.	- Do-	Replace in kind will meet the specification mentioned in the SOW	O.K, Closed		O.K, Closed Still detail of the specifications of the new exhaust shut off and by pass damper awaited from GE		O.K, Closed	
1.25 Fraining	GE propose (Mechanical Maintenance) training program, consist of the basic training. While Marafiq (Mechanical Maintenance	A list of all trainings is sent as part of GE-PBC- ME-002 reply. Marafiq to inform GE on the	Mech. Training:- It is not clear from GE customer courses catalog that which training course is suitable, as it contents limited description regarding the course. Therefore GE WII arranged required training	Trainings are site specific as much as possible for Equipment being supplied by GE.	O.K, Noted. GE has list out all Compliance as per discussion.	Ok will include in Compliance sheet	O.K, Noted. Hope GE will include all the required training in his		Response from GE awaited	During Face to Face to meeting Closed on 1st Nov'2015





ادارة الشَّمْرِيانَ والنَّفِيرِ PROCUREMENT & CONTRACTS DEPT.



1

BID COMMENTS / CLARIFICATIONS

Project: RFP Collective No. PR# 7000006947

Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-ME-003)

Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S lo.	Reference in Bid Document	MARAFIQ comments on 30 th June 2015	Bidder's Response on 1st August 2015	MARAFIQ comments on 9 th August 2015	Bidder's Response on 27 th August 2015	MARAFIQ comments on 29 th August 2015	GE REPSONSE 08SEP2015	MARAFIQ comments on 9 th September 2015	GE Response 13SEP2015	MARAFIQ comments on 16 th September 2015	MARAFIQ comment 02nd Nov 2015
		Team) need special training for all new components such as a) Dismantling/inspection/ assembling of rotor components including clearances and alignment b) Modification and testing procedure of fuel nozzles Maintenance and inspection of water injection system, cooling water radiator skids, Nox control system DLN, Extender parts of hot gas path, full unit uprate of GTG, IGV , dampers exhaust plenum, shut off and by pass dampers	selected trainings to be part of the proposal.	as mentioned in the MARAFIQ last comments. Electrical Training: The Course material for Generator Breaker, MCC (480 V)-Breakers, 4.16 KV Breakers is missing in the catalogue. Even the mentioned Excitation training carnot be selected till the type / version of Excitation-System going to be installed is finalized. Hence, GE shall arrange the required Training suitable as per SOW. 18.C Training:- Provided catalogue is universal and not specific to the SOW. Hence GE shall specify and provide required training as per SOW requirement for controls system by considering the following training as well. A) Site Specific Training 1. Mark Vie Control Maintenance 10 days 2. Mark Vie Control Maintenance 5 days Operator Interface 3. Mark Vie Control Migration from Mark V Control Migration from Mark V Control Migration from Mark V Control Migration from Mark Vie Control Maintenance 5. Mark 6e to DCS Modbus communication, Mark 6e to EX2100 (or latest) communication, Networking, Troubleshooting B) Open Enrollment Training 1. Mark Vie Control Maintenance Advance 2. Mark Vie Control System Intermediate 3. Mark Vie Control System Intermediate 3. Mark Vie Control Trouble Shooting Advance 4. Proficy Cimplicity of turbine control advance				compliance sheet and response is awaited with the list.			
	5.14 Project Scope	As per SOW Hydrogen control panel 3 to 8, in the Proposal unit 3 is missing	Confirm, it will be added accordingly.	O.K, Noted	Noted and Closed.	O.K, Closed					











Project: RFP Collective No. PR# 7000006947

GTG 1-8 Rehabilitations (GE PBC-ME-0037)

Bidder: GE

Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. Vo.	Reference in Bid Document	МА	RAFIQ comment 16 th June	2015	Bidder's Response on 5 th August 2015	MARAFIQ comment 13 th August 2015	GE REPSONSE 13SEP2015	MARAFIQ comment 16 th August 2015	GE Comments 13 October 2015	MARAFIQ comment 14 th Oct 2015	GE Comments 18 October 2015	MARAFIC commen 18 th Oct 2015
	4.7 Full Unit Up	Clause 4.7.1 Mentioned that Required component for uprate of 2055F We have replaced the 1st & 2nd stage Buckets and shroud the following schedule. GTG No Component Replaced period GTG -1 Sep-12 GTG -2 Jun-13 GTG -3 Apr-12 GTG -4 Feb-15 GTG -6 Jun-12 GTG -7 Mar-15 GTG -8 Apr-13 Stocks Available with Our Ware house			1- Kindly refer to the below table for more details about the parts that Marafiq already have (as per GE records) and the design description of those. All parts that are 2055F capable can be re-used. Marafiq to review the	1. Please find updated data's in Red and Green Colours. 2. We will send	Marafiq has provided a detailed inventory file*, excluding details GT5 and GT9. A comprehensive details summary is provided in the table below "Marafiq Installed Parts and description" The following 3 classifications can be made: 1) Can be used for upgrades, parts in use have to be repaired by qualified GE Repair Center: 314B7165G030 Stage 1 Bucket (S1B) 119E1722G029 Stage 1 Nozzle (S1N) 104C1547G005 Stage 1 Shroud (S1S) 314B7166G039 Stage 2 Bucket (S2B)	O.K, Noted 1. O.K, Closed	Closed Correction Only After modification can be used for upgrades, parts in use have to be repaired by qualified GE Repair Center: 116E4050G036 Stage 2 Nozzle (S2N) S2S and S3S in	2) Bidder please confirm existing parts (which are not useable as a PIP package)	For all comment s from 14th October: Bidder confirms parts not useable for PIP package	Close
1	rates for GTG	Stocks Available Descriptions	Part Number	Available In Ware House	part numbers and advise if the installed ones are	updated data's requested in Excel	Only After modification can be used for upgrades, parts in use have to be	2. O.K, Closed	Marafiq Machines cannot meet the PIP package and cannot be modified	like 3 rd stage shrouds, 3 rd stage n	would be consider ed in the exchang	
		1st stage bucket	314B7165G030	03 Sets	different. 2- We sent an	format	repaired by qualified GE Repair Center:		All Other Parts cannot meet the	ozzles, 3 rd stage	e program	
		2nd stage bucket	314B7166G039	03 Sets	excel file with required data		116E4050G036 Stage 2 Nozzle (S2N) 220A242G2G2 Stage 2		requirements for the upgrades	buckets		
		1St stage shrouds	104C1547G005/361A231 3P001	03 Sets	to be able to evaluate the		 329A3482G002 Stage 2 Shroud (S2S) 339A9966G004 Stage 3 			and 2 nd stage shrouds in		
		2nd stage shrouds	329A3482G002	02 Sets	Parts Exchange Program		Shroud (S3S)	3. Please	4) 104C1547G005 is 104C1547G005 stage 1	part		
		against the Performance be replaced under	nat during uprate this compor rmance guarantee. Or else th r Parts Exchange Programm	is component will	Value and still waiting for Marafiq feedback.		3) All Other Parts cannot meet the requirements for the upgrades * Please note some of the Part Numbers Provided, were not per the GE Part Number Format (having additional characters/etc.), this evaluation is based on the Part Numbers listed herein.	added additional information in purpule colour	shroud can be used for performance improvement package 5) 339A9966G004 is stage 3 shroud that cannot meet performance improvement package, this is an updated correction from our previous clarification!	exchange program. 3) Bidder shall confirm Which ever parts not meet out upgrade is it considered in Part		روالياه MARAFIO



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Project: RFP Collective No. PR# 7000006947

Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-ME-003)

Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

6) 111889626004 scAP cold rinner can be used with PIP/Extendor/DLN 7) 11189626004 refers to CAP& LINER ASSEMILARE A	S. No	Reference in Bid Document	MARAFIQ comment 16th June 2015	Bidder's Response on 5 th August 2015	MARAFIQ comment 13 th August 2015	GE REPSONSE 13SEP2015	MARAFIQ comment 16 th August 2015	GE Comments 13 October 2015	MARAFIQ comment 14 th Oct 2015	GE Comments 18 October 2015	MARAFIQ comment 18 th Oct 2015
to CAPR LINER ASSEMBLY, can not be used with PIP/Extendor/DLN 6) Bit con in Exp per per per per per per per per per pe								Collar Inner can not be used with	Exchange program. 4) O.K, Closed		
1. Will GE accept our existing Cl parts will have to be evaluated based on the condition of the parts.								to CAP& LINER ASSEMBLY, can not be used with	5) Bidder shall confirm Which ever parts not		
1. Will GE accept our existing Cl narts.								, , , , , , , , , , , , , , , , , , , ,	meet out upgrade is it considered in Part Exchange program.		
1. Will GE accept our existing CI parts									6) Bidder shall confirm Which ever parts not meet out		
1. Will GE accept our existing CI parts acress our existing CI parts arts A part will have to be evaluated based on the condition of the parts acress our evaluated based on the condition of the parts									upgrade is it considered in Part Exchange program. 7) Bidder shall		
accept our evaluated based on the condition of the parts									confirm Which ever parts not meet out upgrade is it considered in Part Exchange program.		
1a Unit Up rates for GTG under part exchange program? (when these	12	rates for	Jun 10-2				accept our existing CI parts under part exchange program? (when these	evaluated based on the condition of the parts	1 O.K ,Noted		Closed
Page 2 of 6			17 c 2017 1-11-11 11 11 20							(3)	MARAFIQ MARAFIQ





Bidder's Ref. PROPOSAL # 778781-15-YGTZ Rev.0



GTG 1-8 Rehabilitations (GE PBC-ME-003)

Project: RFP Collective No. PR# 7000006947 Bidder: GE

S. No.	Reference in Bid Document	MARAFIQ comment 16th June 2015	Bidder's Response on 5 th August 2015	MARAFIQ comment 13 th August 2015	GE REPSONSE 13SEP2015	MARAFIQ comment 16 th August 2015	GE Comments 13 October 2015	MARAFIQ comment 14 th Oct 2015	GE Comments 18 October 2015	MARAFIQ comment 18 th Oct 2015
		A BUTHER WALLES CONTROL OF THE PROPERTY OF THE				be replaced with extender parts) 2. Is the existing third stage nozzle and third stage bucket are exchange able? 3. The work of replaceme nt of the parts is in progress on GTG-5. 4. During last MI of GTG-9 (Which was completed on 15th august 2015). Capital parts were already replaced.	S3N and S3B can not be used for the PIP Noted noted	2. Bidder shall confirm Which ever parts not meet out upgrade is it considered in Part Exchange program. 3. O.K, Noted, Bidder shall confirm that, the bidder has to be taken considerati on of this part for Uprate, if not the same as considered for Part Exchange program 4. O.K, Noted, Bidder shall confirm that, the bidder has to be taken considerati on of this part for Uprate, if not the same as considered for Part Exchange program.		الياه درانجي MARAFIQ" مقود الرقائد والمقود ال







Project: RFP Collective No. PR# 7000006947	Bidder GE
GTG 1-8 Rehabilitations (GE PBC-ME-003)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

- Marafiq Installed Parts and description

COMPONENT	UNITS	PART NUMBER	ENGINEERING DESCRIPTION
Stage 1 Shroud	298882 298883 291848 291849 291850 291851 291852 291853	361A2374G001	HR-120, Cloth spline (W seal), 2055F, Stage One Shroud The parts available in the warehouse having the part # 361A2313P001 which is not matching with GE Part number, GE to reconfirm. AVAILABLE IN WARE HOUSE 03 SETS under MC NUMBER 201137301 Written on the shroud 104C1547GOO5 5NH459240 E8945
Stage 2 Shroud	248882 248883 291848 291849 291850 281851 281852 281853	329A3482G002	Continuum (TM) Part, Forged SS-310, Pumpkin Tooth, No Honeycomb, 2055 F capable, Stage Two Shroud (MC NUMBER 201137302) PART NUMBER 329A3482G002 AVAILABLE IN WARE HOUSE 02 SETS
Stage 3 Shroud	248882 248883 291848 291849 291850 281851 281852 281853	357B9978G003	SS410 Forged, Pumpkin Tooth, Honeycomb, 2055 F, Stage Three Shroud The parts available in the warehouse having the part # 339A9966G004 which is not matching with GE Part number GE to reconfirm. AVAILABLE IN WARE HOUSE 03 SETS under MC NUMBER 201137303 Written on the shroud 339A9966G004 103E3035P002 REV.G SNH406587 P6443
Stage 1 Bucket	248882 248883 281848 281849 281850 281851 281852 281853	314B7165G030	DS GTD-111., 12 Cooling Holes, GT33 Coating, 2055 F Capable, Stage One Bucket (MC NUMBER 201137285) PART NUMBER 314B7165G030 AVAILABLE IN WARE HOUSE 02 SETS
Stage 2 Bucket	248882 248883 281848 281849 281850 281851 281852 281853	314B7166G039	Continuum (TM) Part, GTD-741, 10 cooling holes, Cutter Teeth, LE Wedge Scallop, Uncoated 2055 F capable, Stage Two Bucket (MC NUMBER 201137286) PART NUMBER 314B7166G039 AVAILABLE IN WARE HOUSE 02 SETS









Project: RFP Collective No. PR# 7000006947	Bidder: GE
GTG 1-8 Rehabilitations (GE PBC-ME-003)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev 0

Stage 3 Bucket	248882 248883 281848 291849 291850 281851 281852 281853	31487167G029	IN-738, Cutter Teeth, Large-Shaped Scallop, Uncoated, 2055 F Capable, Stage Three Bucket (MC NUMBER 201137287) PART NUMBER 314B7167G029 AVAILABLE IN WARE HOUSE 02 SETS
Stage 1 Nozzle	248882 248883 281848 281849 281850 281851 281852 281853	119E1722G029	FSX-414, No TBC, Diffused Cooling Holes, Chordal Hinge, Improve Spline Seal, 2055, Stage One Nozzle (MC NUMBER 201137288) PART NUMBER 119E1722G029 AVAILABLE IN WARE HOUSE 02 SETS
Stage 2 Nozzle	248882 248883 281848 281849 281850 281851 281852 281853	116E4050G032	GTD-222+, Aluminide Coating, Round Cooling Holes, Non-Pressurized, No Brush Seal, 2055 F capable, Stage Two Nozzle The parts available in the warehouse having the part # 116E4050G036 which is not matching with GE Part number GE to reconfirm. AVAILABLE IN WARE HOUSE 02 SETS under MC NUMBER 201137289
	248882 248883 281848 281849 281850 281851 281852 281853	119E1539G012	GTD-241, 2055 F Capable, Stage Three Nozzle (MC NUMBER 201137300) PART NUMBER 119E1539G012 AVAILABLE IN WARE HOUSE 03 SETS

- Combustion Hardware

COMPONENT	UNITS	PART NUMBER	ENGINEERING DESCRIPTION
Fuel Nozzle	248882 248883 281848 281849 281850 e 281851 281852		Standard, No Extendor, Dual Distillate/Gas, 7EA Primary Fuel Nozzle (MC NUMBER NOT TRACEABLE) PART NUMBER NOT TRACEABLE to be reconfirm by GE about the part # AVAILABLE IN WARE HOUSE NOT KNOWN
	281853	156D2054G001	Standard, No Extendor, Dual Distillate/Gas, 7E & 9E Primary Fuel Nozzle (MC NUMBER NOT TRACEABLE) PART NUMBER NOT TRACEABLE to be reconfirm by GE about the part # AVAILABLE IN WARE HOUSE NOT KNOWN











Project: RFP Collective No. PR# 7000006947	Bidder: GE
GTG 1-8 Rehabilitations (GE PBC-ME-003)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

Transition Pieces	248882 248883 281848 281849 281850 281851 281852 281853	899E0143G008	Hastelloy-X, Non DLN, No Aft Frame Cooling, No Staged Dilution Holes, No TBC, 7B & 7E Transition Piece (MC NUMBER 201102665) PART NUMBER 899E0143G008 AVAILABLE IN WARE HOUSE 31 NOS.
Cap & Liners	248882 248883 281848 281849 281850 281851 281852 281853	111E8960G004	Hast-X, Standard, No Extendor, TBC Coating, 2055, Liner 7B The parts available in the warehouse having the part # 111E8962G004 which is not matching with GE Part number GE to reconfirm. AVAILABLE IN WARE HOUSE 01 SET under MC NUMBER 201081300 or MC NUMBER 201137578 Written on the cap and liners 111E8962G004/REV.A V/C 06416 5/N 10-02-859 193B7173G004/REV.N

Note:

Additional information (written on the parts) were mentioned in the related column with "Purple" color.



3.2





Project: RFP Collective No. PR 7000006947

Bidder: GE

GTG 1-8 Rehabilitations.... Clarification # GE PBC-PM-001

Bidder's Ref:

S. Vo.	Reference in Bid Document	MARAFIQ comment on 18 th June 2015	Bidder's Response on 7 th July 2015	MARAFIQ comment on 12th July 2015	Bidders Response 8/27	Status MARAFIQ Response	Marafiq Response 5 th NOV 2015
	Project management	Provide/submit detail Project management. Explain the following as per ITB document in the RFP: 1 CRITICAL EXECUTION ISSUES 2 EXECUTION STRATEGY- Fill the related template Excel Sheet in the RFP. 3 PROJECT HSE PLAN 4 QUALITY MANAGEMENT 5 PROJECT SCHEDULE 6 INTERFACE MANAGEMENT 7 PROJECT LOCATIONS 8 DETAILED ENGINEERING APPROACH 9 PROCUREMENT APPROACH 10 CONSTRUCTION APPROACH 11 COMMISSIONING, TRAINING AND ACCEPTANCE	Please refer to the attached revised project management	Partially Complied and Pending. The following activities are missing from the project management. 1. Procurement support by engineering 2. Site support by Engineering 3. Inspection activities 4. Expedite vendors 5. Logistics and shipment Coordination 6. Material Management 7. Scope of field services 8. Labour Recruitment 9. Construction Sequence 10. Construction Method Statements Include brief narrative description applicable for the proposed project and submit revised project management including above mentioned.	Please refer to attachment for additional details, further information is normally provided at Project Kickoff Meeting. Project Execution Submittal.pdf Marafiq section 5 clarifications_rev 00_	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval.	that GE shall provide further information a
2.	ENGINEERING SERVICES PROBLEMENT PROPERTY OF THE PROPERTY OF T	 Identify its proposed Designers for each major and specialist part of the Works. For which the Bidder intends to carry out design work in-house it shall provide details of recent experience of the design of similar works and C.V's of its lead designers for each required discipline. Identify elements of work to be let on a design or design, supply and erect basis; and any specialist services that it intends to outsource. Details of Designer Subcontractors shall be provided in the Bidder's response to this clause together with recent relevant experience of the design of similar works shall be provided 	Please refer to the attached revised project management. All involved engineers will be defined only after the project award.	1. Complied and Closed. 2. Partially complied and pending. Bidder has not provided CVs of lead engineering and design staff for each discipline. Submit CVs of staffs who will be engaged in detailed engineering and design of proposed project. 3. Not complied and pending. 4. Not complied and pending. Bidder has not provided sub contractor's profile. Bidder must have identified subcontractor for major activities. MARAFIQ needs the subcontractor profile for review.	Please refer to attachment for additional details, further information is normally provided at Project Kickoff Meeting. (attached under item 1)	Kickoff Meeting for MARAFIQ review and approval. 4. Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for	subject to the condition that GE shall provide further information a Project Kickoff Meeting for MARAFIQ review and approval. 3. Noted and Closed subject to the condition that GE shall provide further information a Project Kickoff Meeting for MARAFIQ review and approval. 4. Noted and Closed



Project: RFP Collective No. PR 7000006947

GTG 1-8 Rehabilitations.... Clarification # GE PBC-PM-001

Bidder: GE

Bidder's Ref:

ENGINEERING SERVICES	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. 1 PROJECT ENGINEERING ORGANIZATION 2 DESIGN DELIVERABLES 3 CODES AND STANDARDS 4 CONTROL OF ENGINEERING SOFTWARE 5 CHECKING, APPROVAL AND VERIFICATION OF DESIGN 6 CONTROL OF DESIGN CHANGE 7 PREPARATION OF ENGINEERING SPECIFICATIONS AND REQUISITIONS 8 TECHNICAL BID ANALYSIS 9 DESIGN REVIEW	Please refer to the attached revised project management.	Partially complied and pending. Bidder has not provided PROJECT ENGINEERING ORGANIZATION CHART. Provide Project Engineering Organization chart for MARAFIQ review and approval.	Please refer to attachment for additional details, further information is normally provided at Project Kickoff Meeting. (attached under item 1)	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval.	that GE shall provide further information at
PERMITTING AND CONSENTS	Submit a draft Permitting Plan.	Please refer to the attached revised project management. More details will be provided upon the award of the contract.	Complied and closed.	Closed	Complied and Closed.	Complied and Closed.
DIRECT MATERIALS PROCUREMENT	Provide PROCUREMENT PLAN which shows details as described in 2.4.1	Please refer to the attached revised project management. More details will be provided upon the award of the contract.	Complied and closed.	Closed	Complied and Closed.	Complied and Closed.
SUB-CONTRACTING P.D.E. / Marin P.D.E. / Mari	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. SUB-CONTRACT PLAN SUB-CONTRACTOR MANAGEMENT SUB-CONTRACTING SCOPE	Please refer to the attached revised project management. More details will be provided upon the award of the contract.	Partially Complied and pending. MARAFIQ asks bidder to provide short listed sub contractors' list identified for this project. Bidder to note that only MARAFIQ approved sub-contractors shall be approached and hired to execute the work. Confirm comprehensive vendor list for all items, equipment to be procured by bidder /EPC Contractor shall be provided for MARAFIQ review and approval.	team creates the needed design	Complied and Closed.	Complied and Closed.



Project: RFP Collective No. PR 7000006947

GTG 1-8 Rehabilitations.... Clarification # GE PBC-PM-001

Bidder: GE

Bidder: s Ref:

6	CONSTRUCTION	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. CONSTRUCTION EXECUTION PLAN SITE ESTABLISHMENT AND TEMPORARY FACILITIES WORKING HOURS / ACCESS CONTROL WELFARE PLAN	Please refer to the attached revised project management. More details will be provided upon the award of the contract.	Complied and closed subject to the condition that welfare plan will be provided before award of the contract.	Standard Welfare Plan is normally provided at Project Kickoff Meeting with a more detailed schedule and Project Plan. GE is fully committed to comply with local laws and regulations related to working conditions and assure adequate site facilities, transportation, etc.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval
)	PRE-COMMISSIONING / COMMISSIONING AND TRAINING	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. PRE-COMMISSIONING AND COMMISSIONING ACCEPTANCE TESTING AND HANDOVER TRAINING VENDOR ASSISTANCE PLAN	Please refer to the attached revised project management. More details will be provided upon the award of the contract.	Partially complied and pending. Bidder has not provided vendor assistance plan. Provide the vendor assistance plan for MARAFQI review and approval.	GE's Vendor's will be under the guidance and assistance of GE throughout the project execution, a vendor assistance plan will be submitted along with the vendor short list upon contract award.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval.	subject to the condition that GE shall provide further information at
3	PROJECT CONTROLS PROJECT CONT	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. PLANNING WORK EXECUTION SCHEDULE PROGRESS REPORTING DOCUMENT CONTROL INFORMATION MANAGEMENT	Please refer to the attached revised project management. More details will be provided upon the award of the contract.	Partially complied and pending. Bidder has not provided the requested information on cost control. Bidder has provided only "Attachment 3" which is change order record form. Provide brief narrative how GE will address the cost control issue for the proposed project.	The Final Contract Agreement will contain the Scope of Work; any additional Work not covered by the Agreement, and as usually exercised by MARAFIQ, would be offered at extra work and mutually agreed between the Parties. GE uses several internal processes such as "Fulfilment Five" to assure project execution.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	subject to the condition that GE shall provide





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Project: RFP Collective No. PR 7000006947

GTG 1-8 Rehabilitations.... Clarification # GE PBC-PM-001

Bidder: GE

Bidder: Sef:

1	1			Dortinity complied and reading	Eventiones of VEV CENIOR	Noted and Classed subject to	Noted and Olsand
9	SENIOR PERSONNEL	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. • KEY PROJECT POSITIONS AND RESUMES	Please refer to the attached revised project management for positions and names. CVs will be provided at a later stage	Bidder has not provided resumes of KEY SENIOR PERSONNEL who will be engaged in the proposed project. Provide the resumes of KEY SENIOR PERSONNEL.	Experience of KEY SENIOR PERSONNEL has been provided in attached Engineering clarification in item 1. Further details will be provided with the Project Organization Chart at the time of kickoff meeting.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.
10	ORGANIZATION	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. PROJECT ORGANIZATION ORGANIZATION CHART	Please refer to the attached revised project management.	Complied and closed.	Closed	Complied and closed.	Complied and closed.
)				Partially complied and pending. Bidder has not provided manpower histograms (the resourcing and mobilization of supervisory staff & labor forces).	Manpower Histograms are provided after detailed schedule is established after contract award.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.
11	MANPOWER LETTING LE	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. • MANPOWER TABLES • MANPOWER HISTOGRAMS	Please refer to the attached revised project management for the categories of manpower required at site for different durations. More details will be provided at a later stage	Bidder has not provided construction equipment and supplies plan required for the proposed project. Critical Execution Issues as stated in project management. Bidder to confirm if labour is not available from the local supply for this project requirements, then an application will be made for visas for the expatriate hiring, importation of all the necessary labour requirements. Bidder and his sub-contractor must have minimum visas on hand to bring sufficient qualified manpower to work on this project to meet the agreed project schedule.	- Confirmed, if labor not available locally, Visas will be the responsibility of GE	Complied and Closed.	Complied and Closed.
12	QUALITY ASSURANCE	Include an outline of the plan to develop, control, record, and quality check project drawings and documents	Please refer to the attached revised project management and attachments. GE has already a process in place for all related	Complied and closed.	Closed	Complied and Closed.	Complied and Closed.







Project: RFP Collective No. PR 7000006947

GTG 1-8 Rehabilitations... Clarification # GE PBC-PM-001

Bidder: GE

Bidder: Sef:

	including interfaces with adjacent plant systems. Describe how Vendor & Sub-Contractor drawings will meet the project requirements for content and quality. How will Bidder ensure that all documents and drawings meet project requirements for content and quality thus minimizing rework? Bidder to include how this is managed, controlled and monitored and include how the quality is maintained. Include how and when the engineering audits are carried out through the development of design	activities at site. One GE plan will be completed upon project award and will be based on the attached file in the project management file section 12.				
QUALITY ASSURAN	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. • QUALITY POLICY AND OBJECTIVES • QUALITY ASSURANCE MANUAL • CERTIFICATION	Please refer to the attached revised project management and attachments. GE has already a process in place for all related activities at site. One GE plan will be completed upon project award and will be based on the attached file in the project management file section 12.	Complied and closed.	Closed		
4 HSE MANAGEMEN	Provide details of this part as per the ITB. Details shall cover following points as specified in the ITB. GE has to detail their approach for each of them. • HSE POLICY AND STATISTICS • PROJECT HSE • DESIGN HSE MANAGEMENT • SITE HSE	Please refer to the attached revised project management and attachments related to this section (section 14). GE has already a process in place for all related activities at site. EHS plan will be completed upon project award and will be based on the	Partially complied and pending. There is no section-14 as claimed by bidder in provided document. Bidder has not provided safety statistics of last five (5) year. How will GE manage the safety of the sub-contractors who will work under your direct supervision? List your safety plan for sub-contractors. Provide	will provide EHS engineers round the clock to assure compliance with the safety policy. EHS provisions can be found the Execution Plan attached in item 1.(Complied and Closed.	Complied and Closed.

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Project: RFP Collective No. PR 7000006947

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Bidder: GE

Bidder: Sef:

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			attached file in the project management file section 14.	brief narrative to manage the safety of sub-contractor' staff. Bidder has proposed to work in two shifts during peak time. How will you ensure safety plan (HSE) implementation for double shifts? How will you ensure compliance to National Labour Regulations? How will you make the arrangement for uninterrupted work during officially recognized holidays, religious or other customs? What will be your special arrangement to have uninterrupted work to ensure that work will proceed, as required, during festival and holidays to meet the target date? NOTE FOR Bidder: MARAFIQ has clarified that the site has restricted approach and the job can proceed round the clock under the due supervision of MARAFIQ or the consultant appointed by them. The usual restriction of Holidays and time offs shall have to be maintained. MARAFIQ also clarified that the time is essence of the contract and the job is required to be completed as per the contract schedule mentioned there in.			
15	ENVIRONMENTAL MANAGEMENT	Bidder shall confirm it has an environmental management system in compliance with ISO 14001 or equivalent for the execution of the Project and provide evidence thereof. Bidder shall provide an Environmental Management Plan, which describes the proposed approach, methodology and	Please refer to the attached revised project management and attachments related to this section (section 6). GE has already a process in place for all related activities at site. EHS plan will be completed upon project award and will be based on the attached file in the project management file section 6.	NOT complied and pending. Bidder has not provided ISO14001 (Environment Management Systems), ISO9001 and OHSAS18001 (Occupational Health Safety Administration System) certificates as part of Environment management. Confirm if your firm/company is ISO14001, OHSAS 18001 certified by third party. Bidder has not provided brief narratives/description on how will he minimize the effects of construction activities on environment as part of regulatory compliance with RCER-2010. Environment management plan includes all major step but not limited to	Please find attached: 2014 PW Global ISO 9001 Certificate(s). pt - Bidder will comply to RCER- 2010 as well as all applicable laws and regulations.	Noted and Closed subject to the condition that GE will confirm GE Saudi International Inc. is ISO9001:2008 certified entity and provide remaining ISO14001 and OHSAS18001:2008 certificate	Noted and Closed subject to the condition that GE will confirm GE Saudi International Inc. is ISO9001:2008 certified entity and provide remaining ISO14001 and OHSAS18001:2008 certificate

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Bidder: GE

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deliverables hazardous material handling procedure with MSDS, spill reporting procedure. associated with All procedures must be developed and compliance with implanted in environment friendly both regulatory manner to successfully execute the and project project. Provide documents and environmental confirm your compliance. requirements, as expressed in relevant regulations, Scope of Works and Client corporate policies etc. The Bidder's response shall include how the Royal Commission Environmental Policy and Environmental Regulations, and the Scope of Work will be implemented and should address all aspects of compliance with the Consolidated Permit Program. shall Bidder provide Construction Environmental Management Plan for this project in which the Bidder shall specify how acceptable environmental standards will be maintained throughout construction and explain how this will be carried out in practice with reference training, environmental management and environmental performance reviews.





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Bidder: GE

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16	PROCESS AND SYSTEM DESIGN	shall include a short description of how new Plant and equipment will be connected to the existing system, and in particular shall include details regarding the interfaces	Brief details were provided in the revised project management plan attached section (7.3). More details shall be provided at a later stage	Partially complied and pending. Bidder to confirm tie-in, interfaces with new equipment with existing system shall be performed with minimum outage time.	A typical tie-in approach is attached for your reference. Typical tie-in approach - clarification	Complied and Closed.	Complied and Closed.
17	Spares	Operational spare parts, Testing & Commissioning tools, Special tools as per the SOW: - no list is provided. Provided the list and confirm that these will be provided as part of the scope of supply.	Will be provided along with commercial proposal. Mainly electrical systems will have spare parts; all mechanicals will be direct replacement per the existing.	Partially Complied and pending. How will bidder ensure spare parts requirements for equipment packages from package vendor?	GE recommended spares will be offered. A list of all spares will be provided to Marafiq to choose from.	Complied and Closed.	Complied and Closed.
-18	EXECUTION PLANS	Provide details of this part as per the ITP. Details shall cover following points as specified in the ITP. GE has to detail their approach for each of them. • Mechanical, Electrical & I&C Services • Mechanical, Electrical & I&C Electrical Interfaces • Detailed planning schedule for the project • Interface data requirements from others	Will be provided at a later stage.	NOT complied and pending. Bidder has not provided the requested execution plans. Execution plans shall be provided before award of the contract.	Please refer to Project Execution Plan, a more detailed execution plan is provided after the award of the contract, to be reviewed in the kickoff meeting. (Attached in item 1)	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.
19	DELIVERABLES International Property of the Pr	Bidder is also requested to provide deliverables list, and provide samples of each proposed type of deliverable for similar projects	Will be provided at a later stage.	NOT complied and pending. Bidder has not provided engineering deliverables list applicable for the proposed project. Bidder shall identify the engineering deliverables list and submit for MARAFIQ review. This will avoid and ambiguity, dispute later on during execution of the project.	GE Project Specific drawings for Design and Manufacturing will submitted for Information only to Marafiq. All other applicable drawings and calculations will be submitted to Marafiq for approval. Examples of Drawings not for approval: On base drawings. All FMI Drawings. Control and control panel Excitation drawings. Examples of Drawings for approval will be: Civil drawings /Calculations, Pipe and cable routing Off base Pipe & cable sizing. Demin water tank design, location etc.,	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.





Project: RFP Collective No. PR 7000006947

GTG 1-8 Rehabilitations.... Clarification # GE PBC-PM-001

Bidder: GE

Bidder: Sef:

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					 Demin water transfer and forwarding pumps 		
0	Deviations	Submit Deviation Form duly filled, signed and stamped.	Will be provided at a later stage.	NOT complied and pending. Bidder to provide complete list of all deviations, exceptions and exclusions taken by him. Deviation list must be submitted to MARFAIQ standard format before award of the contract.	Ok	Not complied and pending. MARAFIQ asks GE to provide complete list of deviations, exceptions, exclusions, assumptions considered for the proposed project. This will provide scope clarity for MARAFIQ & GE both.	Complied and Closed
:1	Contract schedule	Submit proposed Level 2 contract schedule in compliance with form of proposal: Contract schedule showing major Contract Activities to be within Contract duration with the aid of Project Evaluation Review Technique – Critical Path Method (PERT-CPM).	Please refer to the attached revised project management and attachments.	Partially Complied and Pending. Project schedule does not include control system replacement, AVR replacement and Gas Flow meter replacement. All these activities will impact project schedule for each GTG. Bidder to include all above mentioned work of Mark-V control system replacement, AVR replacement and Gas Flow meter replacement and revise and resubmit the project schedule for MARAFIQ review.	Schedule for Mark-V control system replacement, AVR replacement and Gas Flow meter replacement are provisioned under GT upgrade Task in the Unit by Unit Outage schedule, additional scheduling details will be provided with the next level project schedule.	Complied and Closed.	Complied and Closed.
3	Organization chart	Submit proposed project organization chart.	Please refer to the attached revised project management and attachments.	Complied and closed.	Closed	Complied and Closed.	Complied and Closed.
24	Experience on similar jobs	Submit details of comprehensive rehabilitation projects experience on similar jobs. The list provided in the technical offer is very generic and it doesn't give details.	Please refer to the attached revised project management and attachments.	NOT complied and pending. Bidder provide list of similar type of projects executed by him with customer name, project cost and customer contact details(Mobile no, E-mail)	Please refer to attached list or Projects. Past Experience.pdf Releasing information on contact details requires approval from GE's Customers, this might take weeks to obtain.	Complied and Closed.	Complied and Closed.
25	Contract schedule	Provide a schedule of the Civil, electrical, Mechanical & Instrumentation work design and construction showing the key design and construction activities and how these activities relate to the electrical design and equipment installation.	Please refer to the attached revised project management and attachments.	Partially Complied and Pending. Project schedule does not include control system replacement, AVR replacement and Gas Flow meter replacement. All these activities will impact project schedule for each GTG. Bidder to include all above mentioned work of Mark-V control system replacement, AVR replacement and Gas Flow meter replacement and	Schedule for Mark-V control system replacement, AVR replacement and Gas Flow meter replacement are provisioned under GT upgrade Task in the Unit by Unit Outage schedule, additional scheduling details will be provided with the next level project schedule.	Complied and Closed.	Complied and Closed.



Project: RFP Collective No. PR 7000006947

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Bidder: GE

Bidder: Sef:

)_				revise and resubmit the project			
3		Provide detailed CV of your proposed Engineers.	Will be provided upon contract award for all assigned team.	site construction manager and site construction staff, HSE safety officer, QA/QC officer, QC inspectors, Construction supervisor, HSE supervisor etc. Bidder has not provided manpower histograms (the resourcing and mobilization of supervisory staff & labor forces). Bidder to confirm labour recruitment shall be done based on the forecast requirements of the labor derived from the planning developed during tendering stage.	Experience of KEY SENIOR PERSONNEL has been providing in attached. Further details will be provided with the Project Organization Chart at the time of kickoff meeting.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.
		Provide organization chart for the Civil design team.	Will be provided upon contract award for all assigned team.		Experience of KEY SENIOR PERSONNEL has been providing in attached. Further details will be provided with the Project Organization Chart at the time of kickoff meeting.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Closed subject to the condition that GE shall provide further information a Project Kickoff Meeting for MARAFIQ review and approval for compliance.
	Senior/ key personnel	Construction Manager.	Will be provided upon contract award for all assigned team.		Experience of KEY SENIOR PERSONNEL has been providing in attached. Further details will be provided with the Project Organization Chart at the time of kickoff meeting.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Closed subject to the condition that GE shall provide further information a Project Kickoff Meeting for MARAFIQ review and approval for compliance.
		Provide organization chart for the Civil construction team.	Will be provided upon contract award for all assigned team.		Please refer to Organizational Charts in Project Execution Plan, further details will be provided after kickoff meeting	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Close subject to the conditio that GE shall provid further information a Project Kickoff Meetin for MARAFIQ review and approval for compliance.
	Comment of the second	Provide CV of Safety Engineer.	Will be provided upon contract award for all assigned team.		All GE Safety engineers are subject to the same rigorous training, cortication and selection criteria, additional details will be provided before the Project Kickoff meeting.	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Close subject to the condition that GE shall provide
A STATE WITH THE	A CONTROL LING OF THE WAY AND	Provide the S-Curve and manpower histogram.	Will be provided upon contract award for all assigned team.		This will be provide with the Level 2 Project Schedule	Noted and Closed subject to the condition that GE shall provide further information at Project Kickoff Meeting for MARAFIQ review and approval for compliance.	Noted and Closed subject to the condition that GE shall provide further information a Project Kickoff Meeting for MARAFIQ review and approval for compliance.
) 27	Project management	Provide a methodology explaining how the Civil, Electrical, Mechanical & Instrumentation design will be undertaken including at which office the design will be done. (This should include a general description of how the design will done for all civil scope items, organization chart and	More details will be provide at a later	Noted and closed subject to the condition that bidder shall provide more details as agreed at later stage.	Closed	Complied and Closed.	Complied and Closed.





civil scope items, organization chart and stage.

GTG 1-8 Rehabilitations.... Clarification # GE PBC-PM-001

Project: RFP Collective No. PR 7000006947

BID COMMENTS / CLARIFICATIONS

Bidder's Ref. Bidder: GE





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Project: RFP Collective No. PR 7000006947

GTG 1-8 Rehabilitations.... Clarification # GE PBC-PM-001

Bidder: GE

Bidder: Sef:

			advise if there is anything else needed.	Coriolis Mass Flow meter etc shall be submitted.	Coriolis Flow Meters. pdf PDF SSOV DWG. pdf		
32	Technical Data	Bidder shall submit all the documents which were not submitted as per the project check list provided.	Please refer to the attached revised project management and attachment and advise if there is anything else needed.	Partially complied and pending. Bidder has not mentioned in proposal for Carrying out all required surveys / studies including interference surveys / mitigation measures.	Bidder confirms conducting the necessary interference studies and mitigation measures as applicable. Surveys have been conducted in form of the site visits. Additional surveys such as Laser Scan are performed after contract award.	Complied and Closed.	Complied and Closed.







Project: RFP Collective No. PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-EE-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

	Reference in Bid Document	MARAFIQ comments on 30 th June 2015	Bidder's Response on 4th August 2015	MARAFIQ Comment On 11 th Aug 2015	GE Reply 26 th Aug 2015	MARAFIQ Response on 31st Aug 2015	GE Reply 2 nd Nov 2015	MARAFIQ Response on 4th Nov 2015	GE Reply 8th Nov 2015	MARAFIC Respons on 9th Nov 201
	Executive Summary (Electrical-related part)									
	Section 2 – Executive Summary; Item #8	What does 'Alternative offer "1" (which has been ticked) mean?	GE has offered one base scope supply as per Marafiq RFP and two alternative bids: 1- Generator Replacement in lieu of Generator rewinding. With this option, this will eliminate any hydrogen related scope as they will all be removed and a new aircooled generator will be installed (similar to GTG9 generator). New foundation will be designed and built as part of GE scope and Excitation system will match the new generators as well. 2- Flange-Flange offer in liue of multiple individual items (uprates, rotors, exhaust, extenders, pipes, DLN). F-F offering is a pre engineering solution that is designed to fit existing 7E units foundation and configuration with minor site work. Since replacement of major parts of the gas turbines has already been considered by Marafiq in this project, this option covers all of the items inside the turbine and comes factory-assembled and tested with zero running hours of all parts (IGVs, compressor rotor, stators and blades, combustion parts, HGP parts, turbine rotor, exhaust frame, casing, bearings).	O.K, Noted	Closed	Noted, but 'Replacement of Generator' is not presented by GE as a detailed proposal for MARAFIQ's evaluation. (Only Generator constructional details have been given). GE to confirm their total unconditional responsibility for successful engineering and execution of the project, if this option is considered.	GE confirms	Closed.		Closed.
	Section 2 – Executive Summary; Item # 8	Under 'Alternative offer "2" "Generator Replacement", it is mentioned "No". But there is Section 4.24 for 'Complete Generator Replacement' in GE's offer. GE to clarify what they are proposing (as base and as Alternative) with respect to 'Generator Rewinding' in Executive Summary.		O.K, Noted	Closed	Noted.				Closed.
	Section 4.8 – Rewinding of Generator stator and Rotor and replacing and retaining rings.									
)	4.8 – Rewinding of Generator stator and Rotor and replacing and retaining rings.	No deviations will be entertained, unless specifically brought out in the specified format with valid technical justifications, for MARAFIQ's review.	Noted	Closed	Closed	GE to confirm that there is no deviation to any clause under this section.	1 item added in the Deviation List, This is a clarification only: Marafiq RFP:	Closed.		Closed.







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BID COMMENTS / CLARIFICATIONS

Project: RFP Collective No. PR# 7000006947

Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-EE-001)

Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

•	Reference in Bid Document	MARAFIQ comments on 30 th June 2015	Bidder's Response on 4 th August 2015	MARAFIQ Comment On 11 th Aug 2015	GE Reply 26 th Aug 2015	MARAFIQ Response on 31st Aug 2015	GE Reply 2 nd Nov 2015	MARAFIQ Response on 4th Nov 2015	GE Reply 8th Nov 2015	MARAFIO Response on 9th Nov 2015
							"Removing the old wiring – The varnish and the insulation must be broken down before the windings can be			
							removed from the stator core." GE Clarification: The winding must			
							be separated before removing from the stator core.			
	Section 4.8: 'Rewinding of Generator stator and rotor and replacing retaining rings'.	GE to provide a clear proposal for this section.	Noted, will be submitted	Not submitted any document as scheduled date	Please find attached typical Scope: FDF GE PBC-EE-001_Ge	GE to confirm that there is no deviation to any clause under this section.	GE confirms compliance to SOW in RFP. Refer to deviation sheet for additional details on clarifications and item 3 above.	Closed.		Closed.
	Section 4.9 – Replacement of AC/DC Power, Control & Instrumentation Cable						above.			
	4.9 – Replacement of AC/DC Power, Control & Instrumentation Cable	No deviations will be entertained, unless specifically brought out in the specified format with valid technical justifications, for MARAFIQ's review.	Noted.	Closed	Closed	Closed	Closed			C losed
)	Section 4.12 – Replacement of Gen.Transfr & Aux.Transfr. Protection Relay by Digital Type						Closed			Closed.





MARAFIQ LE PROCUREMENT & CONTRACTS DEPT.



Project: RFP Collective No. PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-EE-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

Replacement of Protection relays for GTG Units 1,2,3, 4,7 & 8	GE to comply with the MARAFIQ RFP – Section IV-K	Confirm with few comments as below	Noted	Closed	Closed	Closed		Closed.
a.Page 97 & 98 –Clause 4.12.1	The GE make HAS Lockout relay (86) is offered. However as per RFP, Clause D.2 (Page 172), the lockout relays shall be shall be 'Electroswitch' make. Provide Electroswitch make lockout relays.	Confirm	Closed	Closed	Closed	Closed		Closed.
b.Page 98 –Clause 4.12.2	The exclusions are not acceptable. Confirm that the contractor shall fully comply with all requirements of RFP mentioned in Clauses 1.C to 1.G & 2.2.1 (Pages 169-174 & 178 of SOW)	Confirm	Closed	Closed	Closed	Closed		Closed.
	Please explain how over excitation protection is achieved from G60 – Generator Management Relay.	-Over Excitation is achieved by measuring per unit volts/hertz through phase VT or neutral VT. The dedicated ANSI function is "24".We will offer G60 to cover the required functions	- Closed				Closed.	Closed
c. Page 98 & 99 – BOM	- Which relay (87/G or 87-1/G) is used for 40-1/G and 40-2/G functions as shown in MARAFIQ SLD 00Q-P01-673	-(87-1G) and G30(87/G).Both relays can be provided with Loss of excitation(40)	- Which relay will be used finally for loss of excitation (40)	- G30 will be used	Confirm that all relays required for the protection as listed in SOW & SLD included & no deviation taken	Confirmed compliance to SOW		
	 In General modify BOM table for all relays to show various functions for which they are used – for example Generator protection (87) is used for 32/G1, 46/G1 –i.e. show exact nomenclature as shown on SLD and not merely 32 or 46 for which the multifunctional relay is used. 	BOM will be updated as requested and will be submitted separately	-Not submitted any document as scheduled date	- BOM is attached Preliminary Both Marafiq.pd				
	- There are many Time Delay Operating relays such as 62/BF1, 62/G1- These relays are not covered in BOM.	Time delay feature is available as built-in feature of the all the functionality. However, If additional timers are required, it can be programmed in the flex logic	Closed					
	 Confirm that all relays required for GTG protection Panel as shown on SLD and Protection Panels Layout drawings are included. 	- Confirm	Closed					والماه دن







Project: RFP Collective No. PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-EE-001)

Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

/		Confirm	Provide SLD as requested	SLD is prepared in A3	See Comments against Sr. No. 9	Confirm, the attached SLD is	Closed.	Closed
d.Page 99 - SLD	The SLD is not readable – especially the functions noted for Relays adjacent to relay symbols. Please provide SLD separately in A3 size to enable us to determine that all functions of relays as specified in SOW is included.			size and viewing it 100% will provide clarity. Otherwise it shall be printed on A3 and the same shall be submitted for Marafiq Review. SLD is attached for your review.		readable. Visio-Yanbu Marafiq SLD Rev 02		
e.Page 99 – Clause 4.12.3.2	The Contractor to use existing power cables and control cables provided that they are not faulty and are suitable for the protection scheme offered. In case of faulty cables/cables not suitable for the offered system, the contractor shall supply and install all new cables as required by SOW, Ref to clause 1.C,1.D.5 & 1.E (Pages 169,172 & 173)	We confirm that existing cables shall be re-used, any additional cables supply replacement shall be subject to mutually agreed additional charges	No additional charges will be acceptable after award of the Contract. Contractor to include additional charges now.	Confirmed cables to be included		Confirm only faulty cables & cables not suitable for the offered system shall be replaced.	Closed.	Closed.
f. Page 99 – Clause 4.12.3.3	All required documents are available in MARAFIQ library. The contract shall retrieve all required documents from the library.	Noted	Closed	Closed	Closed	Closed		Closed.
g.Page 100 - Clause 4.12.4	All submittals shall be as per clause 1.F (Page 173) & 2.1.3 (Page 177)	Confirm	Closed	Closed	Closed	Closed		Closed.
4.12.2 (Exclusions) Ref: # 3	Bidder need to perform" Scheme modification work".	Confirm, modification related to GE scope of work under this contract.	Noted	Closed	Closed	Closed		Closed.
4.12.2 (Exclusions) Ref: # 4	Bidder need to perform "Reproduction of existing Drawings."	Existing generator protection drawing will be revised and submitted for approval	Closed	Closed	Closed	Closed		Closed.
4.12.2 (Exclusions) Ref: # 1 & 2	Contractor to specifically confirm compliance to Clause # II (1) E5 (Page 172). Contractor to note that the CT connections from the 115 kV Switchgears up to the new protection relays shall be four (4) wires - three phases and common neutral for each CT, thus eliminating the use of Auxiliary CTs.	Confirm,	Closed	Closed	Closed	Closed		Closed.
Section 4.13 – 600 V Draw Out Metal Clad Switchgear								
Section 4.13 600 V Drawout Type Metal Clad Switchgear	GE should comply with requirements specified in MARAFIQ RFP – Section IV L	Noted, more details will be submitted separately	-Not submitted any document as scheduled date	Please find attached	 It appears that GE have not gone properly through 	According to the factory Any exceptions or	Closed, as no deviations found in GE's	Closed.



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Project: RFP Collective No. PR# 7000006947	Bidder: GE	
GTG 1-8 Rehabilitations (GE PBC-EE-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0	

				ARAFIC LV SWG- LAYOUT.PDF	SOW or have not understood it. Sketch shows transformer with primary voltage 12470. Such transformer is not required as per SOW. Note only Five (5) - 600 V Metal Clad SWGRs are required as per section IV L of SOW & Two (2) - 4.16kV / 0.48 kV Secondary Unit Aux. Transformer are required as per Section IV T of SOW. The footprint of SWGRs and Transformers must match with the existing ones.	deviations are stated in the quote letter and in the attached deviation list. The 12470 is just a system generated by default. Actual number will be calculated at the engineering stage Noted for the quantities of the 600V Metal Clad SWGRs GE will attempt to match the footprints as best as possible. All offered lineups are Outdoor (nonwalk-in)	final Deviation List.	
a.Page 102 – BOM – Item 1	Walk in type of LV metal clad switchgear is offered. Walk in type of switchgear is not required. The switchgear should be compact and shall fit in the space available in the switchgear room in the same location where existing switchgear is located. GE to confirm full comply with product specification (Page 187, Clause 4 of SOW) Please confirm that 1 No. of 2500A incomer breaker and 4 Nos. of 1200 A outgoing breaker shall be provided- all breakers with built in GF protection.	- Noted, more details will be submitted separately. We will try out best to match existing foot print during engineering stage, initial dimension of offered switchgear provided with our proposal for reference.	-Not submitted any document	- Please find attached in item 17.	Confirm that 600 V Metal Clad SWGRs shall be supplied exactly as SOW and no deviation will be taken.	equipment. all offered lineups are Outdoor (non-walk-in) equipment Please find attached in item 17. Waveform Capture The Waveform Capture option in the advanced trip unit can track and visualize any fault event. The device tracks eight cycles, four	Closed.	Closed.
TOTAL WALK CONTRACTOR	 Clarify the function of "Waveform Capture"feature incorporated in breaker. 	- Wave capture is diagnostic feature	- Response not received Page 5 of 23		- Response yet not received	before and four after the event, with resolution		المرة الشتريات والمقود أو.

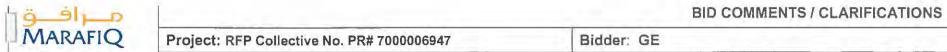




Project: RFP Collective No. PR# 7000006947	Bidder: GE	
GTG 1-8 Rehabilitations (GE PBC-EE-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0	

b.Page 104, Clause 4.13.2.4	GE can use existing power and control cables if they are found healthy. GE to replace faulty cables with new once and shall supply all the additional cables needed for satisfactory operation of 600 V Metal clad switchgear.	GE confirm to use all existing cables, any cable replacement is going to be replaced as per the separate line item in the proposal and RFP.	- Elaborate which diagnostic feature is achieved? See comments against S. No.11	Confirmed cables to be included	- Response yet not received Closed	the results in memory. It registers events in all three phases and the neutral. After the event, the waveform is stored in COMTrade format and can be accessed by using the waveform client module of the Enervista software. (The PMCS system must be connected and running at the time of the event to capture waveform information.) When the upload into this software is complete, the trip unit will reset this function and be available to register the next event.	Closed.
c.Page 104, Clause 4.13.2.5 & 8	Please Confirm Contractor shall retrieve all documents required from MARAFIQ library as per clauses I.1.b & 2.B.1 (Page 181 & 182 of SOW). Also confirm that the contractor shall comply with clauses 2.B.2 &3 (Page 182 of SOW)	Confirm, GE will properly coordinate with Marafiq and collect any document required at the engineering stage.	Noted	Closed	Closed		Closed.





Project: RFP Collective No. PR# 7000006947 Bidder: GE Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0 GTG 1-8 Rehabilitations (GE PBC-EE-001)

d.Page 105 Clause 4.13.5	The Contractor shall supply drawing package as required by clause 3.4(Page 185 of SOW)	LV Swgr drawing will be provided only after getting the order and technical clarification from Marafiq.	Noted	Closed	Closed			Closed.
e.Page 106, Clause 4.13.8	The Contractor to make necessary arrangements for witnessing site test by MARAFIQ Engineer. The optional cost to cover transportation, accommodation etc. shall be considered by Contractor in their commercial offer.	Charges for FAT already provided in our proposal. However, all customer costs (T&L) during FAT shall be customer responsibility.	All FAT charges including T & L shall be included in Commercial offer for MARAFIQ representatives to witness FAT.	Two Integrated FAT test, each with Four People is included, Transportation roundtrip Air tickets from Yanbu, KSA to FAT location and also Lodging and Local transportation will also be included.	Closed			Closed.
f. Page 106, Clause 4.13.9,2,	See comment against Sr. No. 2.c	GE will coordinate with Marafiq and collect any document required at the engineering stage & site survey & site T&C activity	Noted	Closed	Closed			Closed.
g.Page 106, Clauses 4.13.10.5, 711 & 4.13.11	See comments against Sr. No. 2.c& 2.e	GE confirm tore- use all existing cables, any cable replacement is not offered in this SOW, in case required shall be quoted separately or be part of the other line item as per the RFP. The charges for FAT already provided in our quote. Arranging transportation/ accommodation during FAT shall be customer responsibility. For point 7 to 11, refer our proposal for supply scope.	See comment – S. No. 11 See Comment – S. No. 22	Confirmed cables to be included Confirmed compliance per item S. No. 22.	Closed			Closed.
4.13.10 (Exclusions Replacement of 600 V SWGR) Ref# 9	Bidder to explain" Supply of any CTs & PTs & its services not covered in the BOM".	CT & PT required for protection are provided in the swgr. T&C Services are included	Closed	Closed	Closed			Closed.
4.13 (Replacement of 600 V SWGR)	Need to provide Breaker Lifter for each of the Switch gear for easy maintenance. Needs to provide same existing protection relay schemes	Breaker hoist rails w/hoist provides. More details will be sent separately. offered switchgears are as per drawing & specification provided with tender	-Not submitted any document as scheduled date	- Please find attache d in item 17.	- Answer not clear. Attachment against item 17 shows Transformer & 600V Switchgear drawing and no mention of Breaker Lifter. Confirm that breaker lifter will be provided. New 600 V SWGR shall have same protection scheme as existing .Please confirm.	Breaker portable lift truck will be provided for each SWGR lineup Voltage relays have been quoted. Breaker trip units providing: Long Time/Short Time/Instantaneo us/Ground Fault	Closed.	Closed.
19-1 (HTI)/42-1-			Page 7 of 23			Confirmed. SWGR has the		MARAFIQ" المقتود [2] المقتود [2] PROCURÉMENT 8





Project: RFP Collective No. PR# 7000006947	Bidder: GE
GTG 1-8 Rehabilitations (GE PBC-EE-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

Section 4.14 – Genera Breaker Replacement								
4.14 – Generator Brea Replacement	GE has stated, 'This scope is being reviewed by ABB. It will be submitted at a later stage.' GE to submit a detailed technical proposal for MARAFIQ RFP, Section IV M- Replacement of Generator Breakers for Units 1, 2, 3, 4, 7 & 8	Alstom quote has been received and will be submitted to Marafiq . ABB is still working on the proposal and we will submit the same to Marafiq once completed.	-Not submitted any document as scheduled date	Please find attached Q2SA1287S (CALSTOM) - Mara		Noted and confirm compliance per Compliance Table and Deviation Sheet. Marafiq (Rev.01) ABB BOM. pdf	Closed.	Closed
Section 4.16 – Replacement of AVR Digital Excitation Sys					ourig takeri.			







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Project: RFP Collective No. PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-EE-001) Bid

Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

Page 111: GE has stated that 'It is customer's responsibility to either remove the current system or simply not use the system, but provide adequate space for the system offered by GE. '	This statement is totally unacceptable. Please refer the relevant section of SoW, where it is clearly stated 'The scope of supply shall also include services and materials for decommissioning and removal of the existing excitation system & AVRs'. It shall be the Bidder's responsibility for the removal of Old Excitation skid along with AC Exciter & Pilot exciter & modify the existing Turning Gear mechanism to fit to the shaft.	GE M&C proposal will include dismantling of existing excitation controls and diode bridges (all existing non-moving static excitation controls and bridges and installation and commissioning of the new GE static excitation system (dismantling and installation will be done by M&C contractor). GE M&C does not recommend moving the rotating parts as these are integral part of existing generators and removing these weights can make the new generator rotor unbalance and cause inertia issues.	Noted. However, since this there is a deviation to the requirement of 'removal of the existing excitation system', this deviation should be listed in the offer with valid technical justification, for our detailed evaluation. Also, please clarify how GE intends to resolve 'rotor unbalance and inertia issues', for the option of brushless excitation system, like existing GTG # 9.	Existing excitation is static with rotating parts which are mounted on the existing generator rotor. GE is offering static excitation system for the existing units 1 to 8. New exciter will replace the existing non- moving parts. Rotating parts are integrated part of the existing generators so will not be removed. This is to maintain same weights on the rotors as have been without unbalancing the rotor weight.	Please refer to our response for Point # 33.				Closed.
Page 111: GE is recommending to 'remove all the old non-rotating AVRs and diode bridges, leaving rotating parts on shaft so not to change Generator inertia.'	It is not desirable to retain unused equipment at site. As the SoW states, equipment that are no longer used should be decommissioned and removed. GE to offer alternative solutions for maintaining Generator inertia, after removing the old rotating parts.	Please refer to GEM&C note above. Other (3) alternatives are 1) GE PGS to modify existing generators by moving all rotating parts but leaving main set of brushes and slip rings for connections to the new GE static exciter, 2) Modify existing generators by moving all rotating parts, brushes and slip rings and replace all those with a new brushless exciter so to get an AVR applied to them, and 3) change the existing generators with new GE Brushless generators. Exciters for option 2 and 3 will be much smaller and will be Brushless AVRs.	As specified in our SoW, Section IV-O, 2.3, GE is required to conduct a 'Feasibility Study' and provide the recommendation to MARAFIQ, after comparing the different options, particularly 'Static Excitation' and 'Brushless Excitation' systems. (Please also refer Section IV-O, Clause-5 which states that,' The existing Excitation System can be replaced as whole with sophisticate excitation system such as GE EX2100e	Above note applies	For the 'Static Excitation' option, GE to clarify whether there is any feasible alternative solution to solve the 'rotor unbalance and inertia' issues, without having to retain the existing main exciter, pilot exciter etc. in their place without having any functional value? Does the 'Static Excitation' require any other independent emergency power supply for initial excitation during a 'Black-Start' scenario?	As This is a non-GE generator GE's recommendation has been to leave rotating parts on the existing rotor to keep weight balance. GE Static excitation will require 125 Vdc battery power supply for black start (through Field Flashing). It will also require UPS power supply 120 or 220 Vac for exciter controls. Amp requirement	Marafiq's Response: It will be entirely GE's responsibility to study MARAFIQ's existing distribution system and space availability, and determine the feasibility of obtaining the various required power supplies that	GE confirms	Closed. Closed.



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BID COMMENTS / CLARIFICATIONS

Project: RFP Collective No. PR# 7000006947	Bidder: GE
GTG 1-8 Rehabilitations (GE PBC-EE-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

Excitation System or Why 'Modification of from 125 Vdc for they need for equivalent to be existing generators controls is the Static compatible with and replace the approximately Excitation existing GTG sets. It rotating parts with a 15A for each may be replaced with System new brushless exciter' exciter. an Excitation installation, is not being proposed Transformer of as the 'base option', in Please note 125 with respect suitable rating or their latest response?? Vdc is a backup Single exciter with to spare (GE had proposed this to the 120/220 brush/Brushless type capacities and exciter to be matched option as Alternative -Vac so the DC spare source to our existing 2 in their response requirement is on generator capacity dated 4th August 2015 points a constant bases, after conducting to this point). only when the AC available. feasibility study as Has GE any prior is not present. Wherever not described in clause experience of such The DC Amp 2.2.3 of this scope of feasible, GE 'modification', i.e Requirement for work.') should make converting a generator Filed Flashing is Hence GE to their own with 'brush-type approximately provide the excitation' into a 25% of Amp Field provisions. required 'Feasibility 'brushless excitation' No Load (AFNL) Study' document of the generator type? for MARAFIQ's field rating. For review immediately. As discussed, GE to Marafiq propose any option of generators, AFNL excitation, only after is about 300A, so determining clearly current that it is technically requirement for feasible and filed flashing compatible with during black start existing system, based is about 75A. on their experience. Please also refer to The existing our response for Point excitation system # 33. is old and completely obsolete. So the only option available is a complete replacement (minor modification of the existing exciter is NOT recommended). Only other option would be to replace the entire generator with a new GE Brushless generator.



CONTRACTS DEPT.



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BID COMMENTS / CLARIFICATIONS

Project: RFP Collective No. PR# 7000006947	Bidder: GE	
GTG 1-8 Rehabilitations (GE PBC-EE-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0	

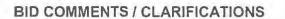
GE does not convert generators from Brush system to Brushless. **GE offered Static** excitation system is best solution based on GE recommendation. Main scope of supply for each Static Exciter will consist of : Full redundant EX2100e (with redundant bridge and controls), Shaft Voltage Suppressor, Field Flashing for Black Start, Power Potential Transformer (PPT, approx. 635 KVA), Customer witness Factory Acceptance Test, Integration with the HMIs and Mark Vle Turbine controls, Local Keypad, Ethernet Switches, PSS (Power System Stabilizer Tuning Studies and PSS Function), Fully configured Field Maintenance Laptop Computer, 1 Set Commissioning ("Level 3") Spares, As stated by GE, new Static exciter The drawing shown is of 'Auxiliary Noted. Please refer to our Please refer to Closed, based Closed. New exciter will Page 111: GE states that will be placed in same room and in response for Point # Compartment' which houses the be located in the updated on conclusion ,'Best possible place for the 30 AVR panels, and not SR cubicle. same place as the existing excitation However all same room as 33. comment in item to go for Static new exciter is in the existing Please refer the SR cubicle system. The control portion of new technical issues, 33 in this file. Excitation the existing SR room in place of the attached again for your ready exciter will not be in the same lineup including space system.





Project: RFP Collective No. PR# 7000006947	Bidder: GE
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	xisting exciter as shown elow'	reference, for dimensions of existing SR. However please refer to our concerns on the proposed 'Static Excitation System' in S.No.16	as new exciter will be wider by existing exciter. But upon our site survey, the same room where the existing exciter is located does have space for exciter control enclosure. So there are no issues with space for the new Exciter.	issue shall be covered in the feasibility study as mentioned in # 29.	static excitation.			
4	age 111. GE states that ' lacement of the new PPT and connections to enerator Aux Bus or to xciter is not included in this offer. This	What does this mean?? Please clarify. This is an EPC contract. So the question of any exclusion of any required work does not arise.	GE M&C will recommend appropriate place for the new PPT. GE M&C scope also includes installation and wiring of the new PPTs (by GE M&C contractor). So no issues there. Issue is the limited MVA capability in customer's existing aux bus. GE M&C has studied customer's existing one line and has determined that customers 4.16KV aux bus does not have MVA capability to power required by new PPT loads. So new PPTs will need to be connected to the existing generator terminals. This means major bus bar work and connection to terminal is required (tapping off the generator terminals). For this to happen, contractor would need the bus work details and designs for the existing generator terminals and connection to existing PT compartment to see where they can make the new tapping. Without these detail bus information and design, GE M&C contractor will NOT be able to quote any bus work connection of the PPTs to existing generator terminals.	MARAFIQ still has concerns about the 'Static Excitation' option, since as GE states, the PPT connection involves 'major bus bar work and connection to terminal is required (tapping off the generator terminals). 'We have a concern that any such major modification could affect the integrity and reliability of the existing generator terminals/ busbar connections. GE to clarify on this issue. The issue of locating the PPT is also not resolved as GE have not identified the exact location. GE should study the other alternatives for Excitation System that they have mentioned in their Point # 29 responses above, and provide a comparative analysis of all the different options in the Feasibility Report. All the technical risks associated with each alternative should be	The BUS Work and connections to generator terminals are included in scope of work. Please refer to item 32 and 33 for further information.	Please refer to our response for Point # 33.	Please refer to the updated comment in item 33 in this file.	Closed.





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Project: RFP Collective No. PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-EE-001) Bidder's Ref: PROPOSAL #778781-15-YGTZ Rev.0

			identified, and their mitigation methods should be detailed in the report. The most reliable option considering the existing system should be recommended in conclusion. MARAFIQ has already provided the G.A Drg. No. 10P076-731 and Construction Details of the Generator. Any further details that they may require, GE has to obtain from site or documentation					
Page 111: GE states that ' PPT primary can be connected to the spare 4.16 KV feeder'.	Has GE verified whether the existing Unit Auxiliary Transformer and (the 4.16 kV Auxiliary Bus of Unit # 5) have enough spare capacity to accommodate the additional load of PPT?? Please note that the existing 4.16 kV Aux. Switchgear Bus receives power from 3 MVA UAT. It supplies power to 2 MVA Secondary UAT and 670 kW turning gear. So kindly clarify where is the provision for supplying additional 630 KVA load for PPT.	Please see above note (item 31)	center. Please see above reply (item 31)	If static excitation is used, we must have PPT. As aux bus does not have MVA capability to feed the PPTs. So PPTs will need to be connected to generator terminals.	Please refer to our response for Point # 33.	Please refer to the updated comment in item 33 in this file.	Closed, based on conclusion to go for Static Excitation system.	Closed.
Page 109: 4.16.1 - 'GE offering in this proposal is based on Static excitation system with Excitation Transformer (PPT).'	Please refer our detailed clarification queries on GE's proposal for 'Static Excitation System'. (Refer Pre-Bid Clarifications # 2). As already raised during Pre-Bid Clarifications stage, MARAFIQ has major concerns (such as Auxiliary Power supply provision, space availability at site etc.), about the feasibility of installing	Please see above note (item 31)	Please see above reply (item 31) Also, GE to clarify why the concept of using Brushless exciter, EX2100e AVR and Mark Vie, (as they are proposing for GTG # 9), is not being proposed by them for the other generators?	recommends 2 options: 1) Changing existing generators to brushless. Then brushless excitation can be used without PPT.	1) What is meant by 'Changing existing generators to brushless'? Does this involve only mounting of a Rotating Rectifier Hub and generator field connections on the existing rotor? Elaborate on the exact components that are required to be 'changed' on the rotating system.	Please note after a thorough evaluation of the existing generator, it was determined by the GE team that this option (option 1 which is conversion of existing Static generator into Brushless) is not a feasible option as this is an old	Closed, based on conclusion to go for Static Excitation system.	Closed.





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Project: RFP Collective No. PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-EE-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

П	the Static	Excitation	System
	proposed	by GE.	

GE has neither given a relevant response, nor addressed MARAFIQ's concerns in their proposal.

Please note that it is GE's responsibility to study the overall feasibility of their excitation plan, including identification of space and layout for the equipment, auxiliary power supply provision, connection arrangements, removal of unused equipment and maintain the integrity of the rotating system.

In view of the above unresolved concerns regarding 'Static Excitation System', GE's current proposal of 'Static Excitation System' is not acceptable. GE should propose alternative solutions, such as the Brushless type Rotating Exciter (as installed in our GTG #9).

Marafiq opinions to replace the Excitation system with latest version of EX2000 with Self Exciter (Brushless) similar as found in GTG # 9. This shall save space requirement for PPT & eliminate Collector Ring for the Static Exciter and reduce machine down time, as the maintenance is minimized for Brush-Less system relative to Brush-Gear system of Excitation.

In view of the above unresolved concerns regarding 'Static Excitation System', GE's current proposal of 'Static Excitation System' is not acceptable. GE should propose alternative solutions, such as the Brushless type Rotating Exciter (as installed in our GTG # 9).

GE to elaborate further how they are going to resolve the concern of 'rotor unbalance and inertia issues', if Brushless exciter is proposed in placed of the existing rotating exciters of generators (except GTG # 9).

All the above issues should be covered comprehensively, with recommended solution in the Feasibility Study for Replacement of Excitation System.

2) existing generators be replaced with new GE brushless generators in that case brushless exciter will be used without a need for PPT or terminal bus connection.

GE does not recommend Using existing generators without converting those to brushless, due to the rotor unbalance and inertia issues.

GE to confirm that this Option # 1 is compatible with existing Generator, and also ensure that there are any 'rotor unbalance and inertia issues' in this arrangement, will be taken care of.

GE to also elaborate on their experience with such 'modifications'.

2) 'Replacing existing generators' with new brushless generators, is being considered as an alternative option.

non-GE generator.

GE neither recommends nor will it change such non-GE generators from Static into Brushless.

As for option 2, it simply means taking existing generator with all its rotating parts out and replacing them with a brand new GE Brushless generator.

New Brushless generator will come with all its rotating exciter already assembled.







Bidder: GE Project: RFP Collective No. PR# 7000006947 Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0 GTG 1-8 Rehabilitations (GE PBC-EE-001)

	GE's justification for changing the excitation system of GTG # 9 to Static Excitation, is not clear. Is GE proposing to change the entire rotating exciter of GTG # 9 to 'Static Excitation', or only the AVR to be changed from EX2000 to EX2100e??	Customer's understanding for unit 9 is not correct. Below is clear GE notes: existing unit 9 is a GE brushless AVR. This AVR is communicating with unit 9 Mark V via old Arcnet communication link. Since customer is changing Mark V on unit 9 to new Mark VIe, he must also change the AVR on unit 9 to new EX2100e AVR. This is because Mark VIe will not be	Noted. However, this being an 'addition' proposed by GE, this should be listed in the 'Deviation List' with technical justification for MARAFIQ's evaluation.	Please see responses in above items.	Please refer to our response for Point # 33.	Please refer to comment 33 in the updated file	Closed, based on conclusion to go for Static Excitation system.	Close
age 112: GE states that,' or Unit 9: Excitation for this	Refer Page 113 of GE's proposal,	able to communicate with existing AVR on unit 9 via Arcnet. Unit 9 will	GE to provide all					
nit is not listed in	it is mentioned that EX2100e can	remain Brushless as it is. Only the	the details as					
istomer's spec for upgrade	be applied to 'Voltage Regulators	AVR will change to the latest technology AVR so all units will be	asked in our previous comment					
t it also needs to be	for Brushless exciters' also. So why the existing excitation system	able to communicate via Ethernet and	under this Item.					
graded because the isting turbine control	of GTG # 9 should be changed to	also to all new HMIs. Hope this is now clear on our statement for unit 9.	GE to clarify why					
ark V) is being upgraded	'Static Excitation System'??	, 5, 4	the same concept of using Brushless					
Mark Vie for unit 9. The	In any case, please refer our		exciter, EX2100e					
ting exciter on GT9 is 2000 AVR which is	concerns on 'Static Excitation		AVR and Mark Vie is not being					
rently communicating	System, and revise the proposal accordingly.		proposed by them					
th the existing Mark V via			for the other generators? The					
cnet (not Ethernet). Since KV on unit 9 is changing to	Bidder shall provide technical		'brushless' option is					
ark Vie, EX2000 needs to	description of the scope of the		preferable from Maintenance point					
o be upgraded to	retrofit involving the installation of a new static exciter dependent		of view, but GE has					
2100e so to be able to mmunicate via Ethernet.	on the nature of the existing		to address all the related issues in					
edless to say the EX2000			the comparative					
obsolete so this is a great	original excitation system.		analysis.					
ne to upgrade that also.			Noted GE's					
this proposal also ludes upgrading unit 9			recommendation for GTG # 9, to					
citer along with above	MARAFIQ asks bidder to provide detailed technical presentation		replace the EX					
tachi units.'	document including basic		2000 with Ex 2100e(or latest),					
	schematics for the excitation		due to					
	system of GTG unit#9 featuring		Obsoleteness of EX2000 and also					
	the replacement of the		for communicability					
	component and retained exiting		with Mark Vie. However for					
	component of excitation system		remaining units GE					باهبالج
Lipide Committee	of GTG #9.		shall propose a comprehensive					JE MAR





Project: RFP Collective No. PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-EE-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

	MARAFIQ asks bidder to confirm does your proposal for GTG#9 include the conversion of brushless rotating exciter to static exciter.		solution for proper selection of the excitation and controls., based on the feasibility study.					
Section 4.18 – MCC replacement for GTGs 1 to 7								
General	GE shall confirm whether all the outgoing feeders of the 480V MCC will have provision to trip the breakers in case of ground fault in the circuit.	Many changed have been noticed. Revised MCC quote will be submitted.	-Not submitted any document as scheduled date	Please find attached	The query is not answered. Please confirm compliance for the query raised by MARAFIQ on 30 June 2015.	Confirmed.	Closed.	Closed.
4.18.1- Work Scope Description – 'As-built Drawings'. GE has stated 'Manually Red Markup only'.	'As-built Drawings' submission shall be as specified in SECTION 01720 - RECORD DOCUMENTS, 1.4 B of RFP. No deviation shall be acceptable without a valid justification and request for approval by MARAFIQ.	As built drawing will be provided only after getting the PO and approved shop drawing with all technical clarification.	Noted	Closed	Closed			Closed.
4.18.2 - BOM	Contractor shall as part of his full responsibility and scope shall check and verify all information provided to him in the SOW document. Contractor is also responsible to retrieve any further data that may be required for detailed engineering, from our Documentation Control Centre/Site for finalizing the requirements and timely completion of work.	Noted	Noted	Closed	Closed			Closed
4.18.3 Factory Tests	What is meant by GE's statement, 'Field testing not included'?? Inspection and Testing requirements shall be, as a minimum, in accordance with Section IV Q-II-6.	Field testing included under IS service at site	Confirm compliance with Section IV Q – II - 6	Compliance confirmed	Closed			Closed.
4.18.4 – Comments	GE's comments are not acceptable. See our response for S.No.3.	No deviation related to site service scope refer our service proposal SOW For Supply scope, full details will be submitted again to Marafiq .	-Not submitted any document as scheduled date	Please find deviation list attached (GE PBC-EE-00 item 39 - IV-F-Sc		Confirm full compliance to removal of existing equipment and installation of new ones according to the offered BOM.	Closed.	Closed.





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BID COMMENTS / CLARIFICATIONS

Project: RFP Collective No. PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-EE-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

4.18.5 – Key Notes – Points # 5 & 6	Not acceptable. See our response for S.No.3	Noted. All deviation will be submitted as part of the deviation list.	Submit deviation List	Please find deviation list attached in 39.	The attached deviation list does not include any deviations to Section 4.18. Hence it is presumed that Contractor will comply with all the clauses without any deviation to Section 4.18.	Confirm full compliance	Closed.	Closed.
4.18.6 - Exclusions	GE's statements are not acceptable. Contractor is fully responsible to execute all the works that may be required to remove the existing MCCs and replace them with the new MCCs. Also please note and comply with the relevant clause in our SoW, that states, 'Contractor will foresee the possible obstruction of existing civil, electrical or mechanical structures around the work area and take advance action in consultation with MARAFIQ so that the work of removal of existing MCC and installation of new MCC will go on smoothly.'.	Noted. All deviation will be submitted as part of the deviation list.	Submit Deviation List	Noted, compliance with SOW confirmed, for any deviation please refer to item 39. attachment.	Please refer to our response to Points # 39 & 40.	Confirm full compliance remove the existing MCCs and installation of new MCCs with all related work.	Closed.	Closed.
4.1.8.7 - Submittal	Please see our response to S.No.2	Regarding supply We will try out best to match existing SWG/MCC foot print during engineering stage, Initial dimension of offered switchgear/MCC provided with our proposal for reference.	Noted	Closed	Noted.			Closed.
4.1.8.8 – Layout and drawings	1. Confirm full compliance to the SoW requirement clause stating, 'Contractor shall match the size of the new MCC with that of the existing MCC. The sequence of order of all the feeders in new MCC shall match with that of the existing MCC so that the cable length is not a problem while re installation. If warranted due to any structural difference with existing MCC, the Contractor shall lay new cable falling short for connection to new MCC. No cable joint will be	Our revised technical details will include all these information. It will be submitted	-Not submitted any document as scheduled date	Please refer Layout drawing for MCC attached S0683BD LV MCC LAYOUT .docx	Please refer to our response to Points # 39 & 40.	Confirmed, Refer to Points # 39 & 40.	Closed.	Closed.





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	Dimensional Data in inches are not acceptable. Please convert to mm. Indicate the overall dimensions of the panels.							
Section: 4.20 Replacement of 4.16kV Switchgear for GTG Units 1,2,3, 4,6, 7 & 8		Will try out best to match existing foot print during engineering stage, Initial dimension of offered switchgear/MCC provided with our proposal for reference.						
Section: 4.20 Replacement of 4.16kV Switchgear for GTG Units 1,2,3, 4,6, 7 & 8	GE should comply with requirements specified in MARAFIQ RFP – Section IV-S.	Overall dimension details will be shown in the technical submittals.	-Not submitted any document as scheduled date	Please refer Layout drawing for SWGR attached.	Required switchgear is MV switchgear. Attached is LV Switchgear not relevant to the required section. Please confirm that supplied equipment shall be exactly as pers SOW	Updated MV Switchgear Layout is enclosed S064AF5 Elevation_1.xlsr	Closed based on GE's confirmation on Item # 45.	Closed.
Page 171–Clause 4.20.1	GE offered replacement of 4.16 kV Switchgear. As per RFP, it is required to retrofit existing switchgear with 4.16 kV Vacuum Circuit Breakers (VCB) and not replacement of entire switchgear (Page 261, Clause II.2 of SOW) The offered VCB shall comply with specification (Page 262, Clause II.4, Page 264, Clause II.5 of SOW). Confirm compliance with SOW and resubmit the proposal for retrofitting of 4.16 kV switchgear.	We are offering a full replacement.	Replacement of Switchgear is not acceptable. Confirm that the existing switchgear will be retrofitted as required by SOW.	GE will provide the commercial proposal for both options, however GE recommends, New SWGR as it will be aligned with the latest industries standard and design practices. New SWGR supply will benefit Marafiq with longer life cycle and less maintenance.	- Confirm that retrofitting of 4.16 kV switchgear will be done as per SOW GE to confirm that the proposal for 4.16 kV switchgear will be Exactly as per SOW and no deviation is taken.	GE confirms retrofitting 4.16 kV switchgear per SOW in Marafiq RFP.	Closed.	Closed
Section 4.21 - Secondary Unit Aux. Transformer								
4.21.1 Work Scope Description	Work Scope Description is incomplete. Contractor to ensure inclusion of all the work items specified as a minimum in Section	We are offering a complete replacement for 4.16KV SWGR. Optional offer is still on-going for retrofit.	As per page 178 of your offer. Clause 4.21 is for the Secondary Unit Auxiliary	This offer is for Transformer. It was a typo error.	GE to confirm compliance to all the clauses under this Section, without any deviation.	No deviations were submitted For this section	Closed.	Closed





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GTG 1-8 Rehabilitations (GE PBC-EE-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0	

	IV T II – 1.Summary Description of Work of RFP.		Transformer and not for 4.16 kV Switchgear.					
4.21.1 Work Scope Description – 'As-built Drawings'. GE has stated 'Manually Red Markup only'.	'As-built Drawings' submission shall be as specified in SECTION 01720 - RECORD DOCUMENTS, 1.4 B of RFP. No deviation shall be acceptable without a valid justification and request for approval by MARAFIQ.	Noted. All deviation will be submitted as part of the deviation list.	Closed.	Closed	Please refer our response to Pont # 46.	As built drawings will be provided after the order is placed and engineering is done. It is typically not provided during the proposal stage.	Closed.	Closed.
Section 4.21.2 – Percent Impedance '7.5 with +/- ANSI Standard Tolerance'	Clarify at what temperature is the given Percent Impedance, and the exact Standard Tolerance values. Our specified requirement is '7.4%, at 110 Deg. C'.	Percent of impedance is tested at a corrected temperature of 100 degree C and has a plus or minus 7.5% ANSI tolerance.	Closed.	Closed	Clarify whether 7.5% is the Percentage Impedance value or ANSI tolerance value.	Tolerance of tested impedance will follow ANSI standards of plus or minus 7.5%	Closed.	Closed.
Dimensions and Weight	GE to confirm that the offered transformer is compatible in all respects, to be located at the existing location of respective Secondary Unit Auxiliary Transformer.	As built drawing will be provided only after getting the order and technically approved drawing from customer.	GE's response does not answer the specific query. Please provide relevant response to the specific query. GE to confirm compliance.	The transformer will be supplied as per attached BOM attached in item 9	Item 9 pertains to protection relays and not relevant to this query. Please provide a categorical confirmation to our original query, 'GE to confirm that the offered transformer is compatible in all respects, to be located at the existing location of respective Secondary Unit Auxiliary Transformer.'	Approximate weight and height are provided in the BOM. EE-001_item 49.	Closed.	Closed.
General Comments and Exceptions – 4.21.3 - 1	The transformer units shall be fully in compliance with the Technical requirements stated in Secion IVT of RFP.	Please see the correct response **	GE's response does not answer the specific query. Please provide relevant response to the specific query. GE to confirm compliance.	** The information provided belongs to line item 48 and we have corrected this. The answer for this item is "The transformer will be supplied as per attached BOM attached in item 9"	Please refer our response to Point # 49.	BOM provided in item 49 Above. If there are any changes required, the changes need to be marked up and they can be revised. The transformer will be supplied with electrical ratings and options as listed on the quote. The unit will be tested per ANSI requirements.	Closed.	Closed.



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General Comments and Exceptions – 4.21.3 – 2 - Testing	Type Test Certificates shall be submitted by Contractor.	Please see the response *	GE to confirm compliance.	*Routine test certificate can be only provided. Type test not available for offered transformer design. Refer our proposal	Explain why Type Test cannot be provided for offered Transformer design.	The unit will be tested per ANSI test standards and a certified test report will be submitted. This test report will contain all data pertaining to testing performed on the customer's unit.	Closed.	Closed.
General Comments and Exceptions – 4.21.3 - 4	Contractor to ensure and confirm that the transformer terminals design is fully compatible with existing primary and secondary interconnection terminals.	The dimensions are approximate at the time of the proposal and the exact dimensions will be provide once the engineering is completed	GE's response does not answer the specific query. Please provide relevant response to the specific query. GE to confirm compliance.	The transformer is provided with cable connection on both side (MV & LV).	Not acceptable. Please note that the transformer terminal connections on both MV and LV sides should be exactly identical to the existing transformers, so as to be compatible for interfacing with existing system. Please refer to Clause II-1(a) of Section IV-T and comply.	Confirm compliance, actual supply will be pending additional confirmation on existing terminal connections on both MV and LV sides, please provide addition information on connection, possibly a drawing.	Closed.	Closed.
General Comments and Exceptions – 4.21.3 - 5 - Dimensions and Weight	See our comment for Sr.No.4.	Approximate Dimensions: Ht 96 in X Wd 102 in X Dp 60 in.Approximate Total Weight: 13100 lbs	Please see our query in Point # 49 and respond accordingly.	The transformer will be supplied as per attached BOM attached in item 9	Please refer our response to Point # 49.	Approximate weight and height are provided in the BOM, see attachment in item 49.	Closed.	Closed.
General Comments and Exceptions – 4.21.3 – 7 – System Study for Voltage Transients	The Transformer Units are fed by 4.16 kV vacuum breakers. Hence Contractor should perform the system study and provide additional protection for voltage transients, if required.		GE to confirm compliance.	The transient protection will be provided if required.	Noted.			Closed.
General Comments and Exceptions – 4.21.3 – 8	Locking System should be same as existing.		GE to confirm compliance.	Confirmed Compliance Alternate Locking Device per SOW will be included	Noted.			Closed.
General Comments and Exceptions – 4.21.3 – 10	See our comment for Sr.No.7		GE to confirm compliance.	Refer to line item # 7 and is already closed	This is not relevant to the said Item # 7. Please see our response to Point # 52 and comply.	Correction, comment updated for #52, please accept clarification per comment #52.	Closed.	Closed.



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Sections 4.21.3 to 4.21.6	Contractor has listed several	Routine test certificate can be only	GE to explain why	Routine test	Explain why Type Test	Please refer to	Closed.	Closed.
	and Exceptions', 'Key Notes', 'Exclusions' and 'Submittal' - Sections 4.21.3 to 4.21.6. Please note that no deviations are acceptable on the RFP requirements. Contractor to confirm clause-by-clause compliance to Section-IVT requirements. If any deviation to any of the specific clause of SoW, it should be submitted in the prescribed 'Deviation List' with valid justification for MARAFIQ's	offered transformer design. Refer our proposal	certificate is not available. Is this a non-standard design? GE to provide UL Test certificate, as a minimum, for identical transformer design.	be only provided. Type test not available for offered transformer design.	offered Transformer design.	The unit will be tested per ANSI test standards and a certified test report will be submitted. This test report will contain all data pertaining to testing performed on the customer's unit.		
1.22.1 Contractual	Table A							Closed.
PTC 22 - Precision) page	1.) The Contractor is required to verify performance of the gas turbine and compressor at 25%, 50%, Base and Peak Load on the Primary and Secondary Fuel used by Marafiq Company for GTG Unit No. 1 - 8. 2.) The purpose of this project is to conduct	1- Noted 2- Noted						
	Turbine frame 7E No.1 – 8							
Performance Testing	1.) The field test should provide a baseline for the gas turbine and compressor at the site of delivery to compare to the factory performance test. 2.)GE has to submit the		-Not submitted any document as scheduled date	The test procedures related to SOW will be submitted in design phase				Closed.
CW Comments	performance test procedure prior conducting the performance test 3.) GE has to submit the performance test report for review and comment. 4.) GE has to submit performance test format	More details will be provided						ع والمياه المرود
	4.22.1 Contractual Performance Test (B&a PTC 22 - Precision) page (186) 4.22.2 Thermal Performance Testing Scope	points under 'General Comments and Exceptions', 'Key Notes', 'Exclusions' and 'Submittal' - Sections 4.21.3 to 4.21.6. Please note that no deviations are acceptable on the RFP requirements. Contractor to confirm clause-by-clause compliance to Section-IVT requirements. If any deviation to any of the specific clause of SoW, it should be submitted in the prescribed 'Deviation List' with valid justification for MARAFIQ's approval. 4.22.1 Contractual Performance Test (B&a PTC 22 - Precision) page (186) Table A 1.) The Contractor is required to verify performance of the gas turbine and compressor at 25%, 50%, Base and Peak Load on the Primary and Secondary Fuel used by Marafiq Company for GTG Unit No. 1 - 8. 2.) The purpose of this project is to conduct performance Test for Gas Turbine frame 7E No.1 - 8 with and without HRSG. 1.) The field test should provide a baseline for the gas turbine and compressor at the site of delivery to compare to the factory performance test. 2.) GE has to submit the performance test report for review and comment.	points under 'General Comments and Exceptions', 'Rey Notes', 'Exclusions' and 'Submittal' - Sections 4.21.3 to 4.21.6. Please note that no deviations are acceptable on the RFP requirements. Contractor to confirm clause-by-clause compliance to Section-IVT requirements. If any deviation to any of the specific clause of SoW, it should be submitted in the prescribed 'Deviation List' with valid justification for MARAFIQ's approval. Table A 1.) The Contractor is required to verify performance of the gas turbine and compressor at 25%, 50%, Base and Peak Load on the Primary and Secondary Fuel used by Marafiq Company for GTG Unit No. 1 - 8. 2.) The purpose of this project is to conduct performance Test for Gas Turbine frame 7E No.1 - 8 with and without HRSG. 1.) The field test should provide a baseline for the gas turbine and compressor at the site of delivery to compare to the factory performance test. 2.) GE has to submit the performance test 3.) GE has to submit the performance test 7.0 GE has to submit the 7	points under 'General Comments and Exceptions', 'Key Notes', 'Sexulusions' and 'Submittal' - Sections 4.21.3 to 4.21.6. Please note that no deviations are acceptable on the RFP requirements. Contractor to confirm clause-by-clause compliance to Section-HVT requirements. If any deviation to any of the specific clause of SoW, it should be submitted in the prescribed Deviation List with valid justification for MARAFIQ's approval. 1.)The Contractor is required to verify performance of the gas turbine and compressor at 25%, 50%, Base and Peak Load on the Primary and Secondary Fuel used by Marafiq Company for GTG Unit No. 1 - 8. 2.) The purpose of this project is to conduct performance Test for Gas Turbine frame 7E No. 1 - 8 with and without HRSG. 1.)The field test should provide a baseline for the gas turbine and compressor at the site of delivery to compare to the factory performance test. 2.)GE has to submit the performance test performance test procedure prior conducting the performance test 7.3. GE has to submit the performance test report for review and comment.	points under 'General Comments and Exceptions', Key Notes', Key Notes', Key Notes', Sections 4.21.3 to 4.21.6. Please note that no deviations are acceptable on the RFP requirements. Contractor to confirm clause-by-clause compliance to Section-IVT requirements. If any deviation to any of the specific clause of SeW, it should be submitted in the prescribed 'Deviation List' with valid justification for MARAFIG's approval. 4.22.1 Contractual Performance Test (B&a PTC 22 - Precision) page (186) 4.22.2 Thermal Performance Test for Gas Turbine frame TE No.1 - 8 with and without HRSG. 1.) The purpose of this project is to conduct performance Test for Gas Turbine frame TE No.1 - 8 with and without HRSG. 1.) The field test should provide a baseline for the gas turbine and compressor at the site of delivery to compare to the factory performance test. 2.) GE has to submit the performance test of delivery to compare to the factory performance test. 3.) GE has to submit the performance test st. 3.) GE has to submit the performance test report for review and comment.	points under "General Comments and Exceptions", Key, Notes, "Exclusions" and Submittation and Exceptions", Key, Notes, "Exclusions" and Submittation and Exceptions and Submittation and Exceptions and Submittation are acceptable on the RF 241-6. Please note that no deviations are acceptable on the RF 241-6. Please note that no deviations are acceptable on the RF 241-6. Please note that no deviations are acceptable on the RF 241-6. Please note that no deviations are acceptable on the RF 241-6. Please note that no deviation are acceptable on the RF 241-6. Please note that no deviation are acceptable on the RF 241-6. Please note that no deviation are acceptable on the RF 241-6. Please note that no deviation are acceptable on the RF 241-6. Please note that no deviation are acceptable on the RF 241-6. Please note that no deviation are acceptable on the RF 241-6. Please note that no deviation to many of the specific clause of ScW, it is hould be submitted in the prescribed "Deviation List" with valid plustification for MARAFIC's approval. Table A Table A 2.) The purpose of this project is to conduct performance Test for Gas Turbine frame TE No.1 - 8 with and without HRSG. 1.) The purpose of this project is to conduct performance Test for Gas Turbine frame TE No.1 - 8 with and without HRSG. 2.) The purpose of this project is to conduct performance test should provide a baseline for the gas turbine and compressor at the site of delivery to compare to the factory performance test. 2.) Cile has to submit the performance test sport for review and comment. More details will be provided performance test sport for review and comment.	points under 'General Comments and Exceptions', Key Notes', Exclusions and Submittal' Sections 42.13 ib 42.16. Bereford transformer design, Refer our proposal series only available is this an own series of the provided of the provided of the provided of the control of th	points under 'General Comments' and Exceptions', Key Motes', Textusional and Submittat' and Exceptions', Key Motes', Textusional and Submittat' and Submittat' and Exceptions', Key Motes', Textusional and Exceptions', Key Motes', Textusional and Exceptions', Textusional and Exceptional and Ex





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GTG 1-8 Rehabilitations (GE PBC-EE-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0	





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Project: RFP Collective No. PR# 7000006947	Bidder: GE	
GTG 1-8 Rehabilitations (GE PBC-EE-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0	

has offered 'Generator	and have proven to be successful fit.			
Replacement', quoted as an	All required modification is already			
Option'.	included as part of GE scope of supply including engineering, design,			
GE should provide technical	foundation, dismantling the existing		1	
	generator and installation the new			
option, including the comparative	load coupling to the turbine.			
study with reference to the base				
option of 'Rewinding', for		4		1
MARAFIQ's evaluation.		1		
GE should elaborate on all the		1		
technical implications of replacing		1		
the existing Hydrogen-cooled				
Generators with the offered 'Air-				
Cooled' generators, in terms of				
size, dimensions, compatibility and		1	1	
interfacing with existing equipment, modifications required				
on the existing equipment,				P
maintaining integrity and dynamic				
balancing of the Rotor System,				
and any other such technical				
Factors.				







Project: RFP Collective No. PR# 7000006947 Bidder: GE

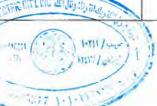
GTG 1-8 Rehabilitations (GE PBC-EE-002)

Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comments on 8th July 2015	Bidder's Response on 1st August 2015	MARAFIQ comments on 05 th August 2015
1.		GE's offer (BOM), relay type G60 used for the function "Generator overall differential protection (87-1)" is not acceptable. It shall be from a different manufacturer or at least different model.	Noted. GE will use different model G60 and G30 for 87,87-1 functionality	O.K, Closed
2.	4.12.1 Replacement	GE's offer (BOM), whether the stator earth fault protection (64G) is 95% or 100%. Will any Injection unit will be required or not?	We can provide both 95% and 100% stator earth fault protection. 100% stator earth can be achieved by either third harmonic neutral under voltage method or sub harmonic injection method. Additional module will be required if we have to use sub harmonic injection method.	O.K, Closed
3.	of Generator Transformer & Auxiliary Transformer	GE's offer (BOM), 64B The Bus Earth protection shall have separate relay.	Confirm	O.K, Closed
4.	protection relay by Digital Type	GE's offer (BOM), select different models or different manufacturers for 87T & 87-1T functions.	Noted, GE will offer different model T60 and T35 for 87T&87-1T functions	O.K, Closed
5.		GE's offer (BOM), There shall be separate relays for Exciter Overcurrent, Synchro check and CB Fail and shall not be included in main relays	Confirm for Synchronizing check and CB fail. We intend to propose static exciter which will have built-in over current and ground fault protection. In case existing exciter system is to be used we shall propose over current relay for 51F function.	O.K, Closed
6.		Exclusions, item#5 which is regarding laying of new cables and terminations. It is to be noted that there are CTs coming from 115KV switchyard (building 23), the	Confirm	O.K, Closed



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BID COMMENTS / CLARIFICATIONS				
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GTG 1-8 Rehabilitations (GE PBC-EE-002)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0			

		new protection will require laying of new cables. Exclusion to this work is not acceptable.		
7.		Exclusions item#4 (Reproduction of existing drawings). Contractor has to revise the existing drawings and submit for approval before finalizing for As-Built.	Existing generator protection drawing will be revised and submitted for approval	O.K, Closed
8.		GE's offer (BOM), Lockout relays shall be from "Electro switch" with coil supervision relays as per SOW.	Confirm	O.K, Closed
9.		GE's offer (BOM), Separate relays shall be provided for the Main Transformer and Unit Auxiliary Transformer HV O/C and Neutral Overcurrent.	Confirm	O.K, Closed
10.	General	The same protection philosophy shall be followed, as used for GTG 5 & 6.	Confirm, existing protection scheme shall be followed	Confirm







Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
		Bidder has specified addition of SSOV and vent lines are needed. Bidder has specified SSOV needs instrument air to operate SSOV. There are SSOV valves available which operates on the line fluid (gas) like slam shut off valve. Why bidder has not specified to use Slam Shut off valve which does not need instrument air?	SSOV 389A4294P101 SSOV Vent These valves are designed to	Complied and Closed. Complied and Closed.		
1.	1- Marafiq YANBU - Plant Rehab- 778781-15- YGTZ_Technical_ Rev0 Page-9 Section-2 Executive Summary Additional Equipment Considerations	 Bidder has not provided catalogues, brochures of SSOV (Safety Shut Off and Vent Valve). Bidder to provide catalogues, brochures of proposed safety shut off vent valve(SSOV) Bidder to provide the instrument air capacity (Flow rate) required to operate the SSOV. Existing Instrument air is not sufficient to actuate the valve as required. There is separate project for up-gradation of instrument air compressors. Bidder has mentioned SSOV and Coriolis flow maters are not explosion, proof devices. 		3. Partially complied. Bidder to provide instrument air capacity including the required air pressure to actuate the	Please find attached DWG on SSOV	Complied and Closed.
	Considerations	meter are not explosion proof devices. MARAFIQ asks bidder to provide explosion proof SSOV and Coriolis Flow meter device since fluid is Sales Gas and minimum area classification is Class I, Division 2, and Group-B. 5. Bidder has specified Coriolis Flow meter not Orifice Based Flow meter per RFP. This is deviation per RFP. Bidder to confirm proposal includes Coriolis Flow meter as deviation to Orifice Based flow meter. As per SAES-Y-101,	[[1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	valve. 4. Noted. Closed.	Ser. MA	RAFIQ TEC

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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-l&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
		the flow meter type shall be orifice be Coriolis Flow meter. Please provide just for selection of proposed Coriolis flow Provide the comparative study of Or Coriolis flow meter for sales gas flow reach GTG. 6. Bidder to confirm modification and adapturbine and load compartments incluengineering required shall be include regular item in base proposal. Bidder has that " an extensive site assessment to take place to identify and addressissues, including the development drawings and installation instructions, shipment. These tasks are mentioned have reference, but fall outside of the scop proposal and would have to be separately." This is not acceptable to M. Bidder to include the required extensive site assessment at this st separate quote at later stage for extensive site assessment at this st separate quote at later stage for extensive site assessment at this st separate quote at later stage for extensive site assessment, which have effective since August 2008." Bidder to proposal includes the compliance of each of the compliance of each o	converted to a volumetric flowrate to compare with the fuel delivery bills. 6. Proposal will be updated. 6. Proposal will be updated. 7. No analysis has been done the fire protection system. Will update proposal with upgrades needed on fire protection. Will need fire protection system details for discharges and overall volume of bottles. 8. On site walkdown and photos does not properly evaluate the operating condition of the equipment. If equipment is not operating properly and requires	5. Noted. Comment is closed subject to the condition that bidder will specify deviation for proposing Coriolis Flow meter in place of Orifice Meter. 6. Partially complied and pending. 7. Not complied and pending. Bidder to include analysis of existing Fire Protection system and required modification to comply with NFPA 12-2008. 8. Not complied and pending.	The second secon	FEM & C





Bidder: GE Project: RFP Collective No. YNB-PR# 7000006947

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
		unit existing fire protection system with latest NFPA 12 requirements effective since Aug 2008. Proposal shall include the required modification of existing fire protection for compliance with latest NFPA 12. 8. Bidder has stated in his proposal "If after the onsite engineering assessment it is determined that new equipment is required to ensure compatibility and safe operation, the details and cost of such equipment will have to be added to the scope herein presented." This is totally not acceptable. Bidder has visited the sites, collected the photos and existing drawings. All the required modification including the new equipment for proposed project shall be included in base proposal. Any claim of raising such requirement of new equipment after award of the contract will not be accepted and entertained by MARAFIQ.	handled as scope adders.	Since this is an EPC contract, all cost related to engineering assessment shall be reflected in the form proposal. Any excuse to add items for ensure compatibility at later stage shall not be entertained.	are included in the Scope provided by Bidder. 7. Bidder will offer the latest fire protection system and provide additional technical details will be provided.	Complied and Closed. Complied and Closed.
			The state of the s	عاملیان در المیان المی	8. All cost related to engineering assessment is Lump Sum for the Scope and Schedule Provided	

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BID COMMENTS / CLARIFICATIONS Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

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GTG 1-8 Rehabilitations (GE PBC-I&C-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0	Bidder's Re	

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
2.	4.1 Cooling Water Radiator Skids	 Bidder to include SMART pressure transmitter and EMF (Electromagnetic Flow meter) for each cooling water radiator skids on common discharge header supplying cooling water to turbine and auxiliaries of GTG. These instruments (Pressure Transmitter and Flow meter) will be interfaced and integrated to MARK-Vie upgraded system. Discharge Pressure and Cooling Water Flow rate signal are required to conduct the performance test of each radiator skid. Provide the catalogue, brochures of pressure transmitter, Electromagnetic Flow meter. Bidder to include Magnetic Type Level Gauge and Level Switch for static Head Expansion tank of each cooling water radiator skid. Bidder to confirm the proposed estimated size of cooling water radiator skids (27Ft X 60Ft) will be fitted in existing foot print available at site for each GTG. 	See vendor datasheet. To confirm all devices. 1. There is a discharge flowmeter on the cooling water pumps. 2. Level indication on the expansion tanks will be confirmed with vendor. 3. The estimated size of the skid is 31ft x 64ft. New foundation pads will be poured for this footprint. Due to the increased cooling capacity, the skid is bigger.	1. Complied and Closed. 2. Complied and Closed. 3. Complied and Closed.		Complied and Closed Complied and Closed Complied and Closed









Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001)

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S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dto 29.08.2015
3	4.2 NOx Control System-Water Injection	1. Bidder to confirm proposal includes centralized water injection package as specified in RFP for DM water transfer, storage, and distribution facility as shown in proposal drawing. This will include DM water tank, piping, Pump with motor, Cables, Field instruments, Mechanical, Electrical, Civil and Instrumentation and Control Work including cathodic protection as required.	 A centralized Water tank and forwarding skid to all the Units. Each unit will have an water injection skid controlled by its own turbine control panel. Injection system is not an option that GE provides. The proposal includes a Water Injection system per unit 	Complied and Closed. Complied and Closed. Complied and Closed.		Complied and Closed. Complied and Closed. Complied and Closed.
4	4.3 NOx Control System-DLN	 Bidder has not specified the location and function of gas control module for this project. Specify how bidder retrofit DLN to existing system will. What are the modifications required for retrofitting of DLN to existing combustion system for each GTG. How will bidder propose to interface Gas Control Module to existing Speed Ratio, Stop Ratio Valve? 	Kindly see marked up drawing attached.	1. Complied and Closed. 2. Not complied and Pending.	2. DLN: new Gas Control Module and SRV will be supplied, old one will be removed	Complied and Closed.

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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
5	4.4 Speed Tronic from Mark V to Mark VIe upgrades	 Confirm proposal includes HAZOP study and SIL assessment/determination using LOPA (Layer of Protection Analysis) methodology. Bidder to provide MARAFIQ consolidated database of HAZOP and SIL Study which will be used later on for SIL validation. Bidder shall provide SIL study recommendation along with cost estimate for implementation of SIL study. Confirm proposal includes a GE factory engineer to convert the operating site software, to perform a software audit of translated code, to perform simulation testing, and to archive software for unit records. The bidder shall provide MARAFIQ an electronic copy of the conversion software so that the Field Engineer will install in the new Mark* VIe hardware and download in the HMI. During the installation, the Field Engineer will exercise off-line and on-line procedures to test the newly enhanced Mark* VIe, HMI, and network solution. 	1. Proposal already included HAZOP and SIL assessment for GT 1-8 and GT9. M&C can provide the cost for including SIL capability on turbine control system, implementation of the study and validation activities as prescribed by IEC 61511 is not part of M&C scope. 2. Confirm 3. Confirm	P.O. CY Teell (1/400 1 (1/400)	Complied and Closed. Complied and Closed. Complied and Closed.
5	4.4 Speed Tronic from Mark V to	Bidder to confirm the proposal includes HAZOP study and SIL assessment using	Confirm	Complied and Closed.	13	AFIQ LICENSTA





Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
	Mark VIe upgrades Exclusions/Excepti ons Buyer acknowledges that the system is provided as SIL capable and it is the responsibility of the Buyer to perform the Safety Lifecycle activities to validate system per IEC 61511, if desired by Buyer.	LOPA methodology. SIL recommendation shall be provided to MARAFIQ for validation and implementation.			1-11/400 1-15 1-15 1-15 1-15 1-15 1-15 1-15 1-	Complied and Closed.
6	4.4 Speed Tronic from Mark V to Mark Vie upgrades Instrumentation	 Bidder has mentioned RVDT for each GTG 1-8. RFP specifies LVDT in place of existing RVDT. Confirm existing RVDT will be replaced by LVDT. If not, bidder will provide justification why existing RVDT cannot be replaced with LVDT. Confirm the bidder shall study the incompatibility of the Mark VIe with the existing field devices used in our Frame-7E and EA like four-wire pressure transmitter, the proposal shall also include new two (2) two-wire 96FG and one (1) 96CD transmitter 	 RVDT will not be replaced, justification will be provided. Confirmed the replacement of incompatible devices included Confirm, will be part of turnkey activities. 	1 Partially complied. Provide justification why RVDT shall not be replaced. List it as deviation in proposal. 2.Complied and closed.	Please note qty 2 LVDTs per unit will be supplied, 18 Total, as part of the Control upgrade, please disregard previous comments	Complied and Closed.



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PROCUREMENT & CONTRACTS DEPT.

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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
		per unit, to replace the existing four-wire transmitters. Bidder to study the existing system and shall replace existing transmitters/other field devices of GT#1-9 which are not compatible with proposed MK-VIe unit for GT#1. This is in addition to existing 96FG and one-96CD transmitters. 3. Confirm conduit, wiring or piping modifications and installation drawings that might be necessary for the Installation of these transmitters shall be included in bidder's proposal.		3. Complied and closed.		Complied and Closed. Complied and Closed.
7	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-52 GE provides the following scope of supply estimate:	1. Bidder has stated no of days as duration required for installation, testing commissioning, start up support, historian, excitation system interface and performance run per unit. Bidder shall confirm that for each unit above activities shall be carried out on turnkey lump sump basis. MARAFIQ shall not pay for extra days incurred towards above activities against the estimate.	As long as no delays to the schedule are from MARAFIQ side or based on MARAFIQ required modification on schedule, no extra days will be incurred to MARAFIQ	This is an EPC contract. Bidder shall be responsible to include all the cost related to installation, testing, commissioning, start up support, historian, excitation system interface and performance run per unit any delays. Bidder to quote for	Bidder confirms the number of man-days is on lump sum basis to the manpower scope and schedule.	Complied and Closed.

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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL #778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
				installation, testing and commissioning on lump sump basis for each unit in his proposal.		
8	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-53 Assumptions and Clarifications:	 Bidder has stated "The services prices are based on work performed in 2016. Work performed after 2016 may be subject to escalation." This is totally not acceptable since this contract is EPC contract. Bidder has to include all escalation in firm proposal. Any exclusion of escalation will not be entertained later on at any cost. Confirm. Bidder has stated "Additional work (hours) will be billed at our published GE Services rate schedule in effect at the time of the work in lieu of a pre-existing rate agreement in effect at the time of the work." This is totally not acceptable to MARAFIQ. Bidder to bear all expenses incurred towards additional hours worked since this is EPC contract. Confirm 	1. Please to indicate expected time of execution – if after 2016 - to include the escalation needed based on that. 2. Please refer to response of point (7) above 3. Confirm 4. This refers to delays caused by MARAFIQ and not related to GE responsibility. Please refer to response of point (7) above	1. Project duration of 36months is already specified in RFP. Expected Project Start date is early 2016 from NTP after award of the contract. Based on this data bidder shall calculate and include all the escalation in his proposal. No excuse for escalation will be entertained later on.	1.Noted	Complied and Closed.





Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001)

Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
		 Bidder has stated "Also included are lodging/living and local transportation costs". MARAFIQ shall not pay for any additional cost for extra work claimed by bidder. Bidder to include all cost in his proposal. Confirm. Bidder has stated "Standby time will be charged to customer in the event of any unforeseen work delays beyond GE's control." MARAFIQ is not responsible for any delays caused. If material didn't' arrive at the site, engineer is not available at site why MARAFIQ shall pay to bidder for delays. MARAFIQ shall not pay for any additional cost for delays caused and claimed by bidder. Bidder to include all cost in his proposal. Confirm. 		2. This is an EPC contract. Bidder shall be responsible to include all the cost related to installation, testing, commissioning, start up support, historian, excitation system interface and performance run per unit any delays. Bidder to quote for installation, testing and commissioning on lump sump basis for each unit in his proposal. 3. Complied and Closed. 4. This is an EPC contract. Bidder	2. Bidder confirms the number of man-days is on lump sum basis to the manpower scope and schedule.	1-111/400 111W/0-0-17





Bidder: GE Project: RFP Collective No. YNB-PR# 7000006947

GTG 1-8 Rehabilitations (GE PBC-I&C-001)

Bidder's Ref: PROPOSAL #778781-15-YGTZ Rev.0

. Document submission)	Bidder's Response	MARAFIQ Response	8/27	MARAFIQ Response dto 29.08.2015
		shall be responsible to include all the cost related to installation, testing, commissioning, start up support, historian, excitation system interface and performance run per unit any delays. Bidder to quote for installation, testing and commissioning on lump sump basis for each unit in his proposal.	4. Bidder confirms the number of man-days is on lump sum basis to the manpower scope and schedule.	Complied and Closed





Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
9	4.4 Speed Tronic from Mark V to Mark VIe upgrades Reuter Stokes Flame Detectors	Bidder to confirm conduit, wiring and installation drawing for modifications to install these detectors are in bidder's scope not in MARAFIQ's scope. 2.	Confirm		confirmed	Complied and Closed.
10	4.4 Speed Tronic from Mark V to Mark VIe upgrades Base Scope Page-49 Cisco VLAN Network Communications Switches for Redundant UDH and Redundant PDH	Confirm network switches shall be of industrial grade and shall be UL listed. Confirm proposal includes Ethernet network cable or Fiber optic cable and termination devices shall be a part of bidder's scope and shall be included in proposal. Bidder to provide catalogues of Ethernet network switch and associated cables.	1. Confirm 2. Confirm 3. Will be provided with Material supply Output Description:	Complied and Closed. Complied and Closed. Complied and Closed. Complied and Closed. MARAFIQ	1. Cisco 2960X are Industry standard but environm ental Ratings are for RoHS not UL certified. 2. Excluded Ethernet, Fiber optic Cables are excluded from M&C scope of supply.E	1. Not ed and Clos ed. 2. Not ed and Clos ed. 3. Not ed.



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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
					PC/ P&W need to include these. 3. Noted.	
11	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis 1. All demolition / installation / commissio ning manpower and materials not mentioned in this Proposal	This is not acceptable to MARAFIQ. Bidder to include all activities required for demolition/ installation/ commissioning for up gradation of existing Mark-V to Mark Vie. Confirm.	Confirm regarding the MK V to MK VIe scope.	1. Complied and Closed.	y MAR	AFIQ LES





Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL #778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dto 29.08.2015
	are not part of the Seller's scope of work.					
12	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis The proposed Bill of Material is an estimate based on Seller's knowledge of this unit at the time of writing this Proposal. Any deviation from the list presented shall result in a corresponding adjustment (up or	Bidder's justification for revising the proposal after award of the contract is not acceptable to MARAFIQ. MARAFIQ has provided all the existing drawings, I/O list, Tag list, P&IDs etc required for this project. Bidder has conducted site visit so many times. Bidder shall note that proposal shall not be revised after award of the contract including the price. Bidder shall note that cost and associated deviation observed, assessment of site during site survey by bidder after award of the contract shall be borne by bidder not MARAFIQ. Confirm.	Price revision will be ONLY in condition that scope modification is requested by MARAFIQ beyond what was proposed in M&C proposal.	Not complied and pending. This is an EPC contract. Bidder is focal point and EPC contractor for this project. Bidder is responsible for his subcontractor's proposal (M&C) agreed scope between bidder and subcontractor. Any dispute or grey area regarding scope of work between bidder and his sub-	Bidder confirms complying to MSOW with the prices proposed in the Commercial Proposal.	Complied and Closed.



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BID COMM			
Project: RFP Collective No. YNB-PR# 7000006947	Bidder: GE		
GTG 1-8 Rehabilitations (GE PBC-I&C-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0		

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dto 29.08.2015
	down) in the Proposal price.			contractor shall be resolved prior to submitting proposal. MARAFIQ is not responsible for the sub contractor's proposal submitted to Bidder (EPC contractor).		
13	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis Seller reserves the right to review and requote this job if there is a discrepancy between this proposal and the purchase order. If Seller receives a	Bidder shall note that review and re-quote of the proposal after ward of the contract is not acceptable to MARAFIQ. Confirm.	Revision is conditioned by statement: "if there is a discrepancy between this proposal and the purchase order" if this is not the case then no quote revision will be claimed	Noted and closed.	Closed Closed Marafi PROCUREME	Complied and Closed

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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001)

Bidder's Ref: PROPOSAL #778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dto 29.08.2015
	specification between the issuance date of this proposal and receipt of the purchase order, Seller reserves the right to re- evaluate this proposal.					
14	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis It is assumed any items (such as cabling, sensors, field devices) are not being replaced in this Work Scope are in a good working order. Replacement of	Bidder shall confirm that internal panel wiring, associated field cable termination is part of SOW. Sensors and Field devices which are not compatible with new MARK-Vie systems shall be included in bidder's scope for replacement. Confirm sensors and field devices which are not compatible with proposed MARK-Vie up gradation shall be included in proposal for replacement including the associated cabling and conduits of those devices.	Confirm, however the existing instruments compatible with MK VIe are expected to be functioning, it will not be responsibility of M&C in case any proved malfunctioning.	Noted and closed.	The state of the s	Complied and Closed



Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL #778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dto 29.08.2015
	any items determined bad is not part of this Proposal. Site Survey results may necessitate the design and installation of additional cabling and devices and a corresponding adjustment to the pricing and delivery as presented.					
15	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis DLN tuning is to be performed by others.	Bidder has offered NOx Control System-DLN in his proposal. So DLN tuning shall be included in his proposal. MARAFIQ shall not be responsible either for hiring or approaching qualified staff for DLN tuning. As an EPC contract, bidder shall be solely responsible to arrange the qualified DLN tuning specialist/staff for DLN tuning for proposed GTG rehabilitation.	DLN tuning to be done by GE	Complied and closed.	noted noted	Complied and Closed



Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL #778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dto 29.08.2015
16	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis It is assumed Seller will be furnished with full drawings and information concerning the state of the existing installation, especially wiring information to the existing terminations within the control panels. If such information is not available Seller will charge for the	MARAFIQ has provided all the drawings, tags lit, I/O List for the Mark-V up gradation work. Bidder shall be responsible to retrieve all the drawings and related information of existing Mark-V system from MARAFIQ documentation centre. Bidder to confirm MARAFIQ shall not pay any charge for retrieving of drawings, documents and information related to this project.	Confirm	Complied and closed.	MARAFIQ PROCUREMENT & CONTRACTS DEPT.	Complied and Closed



Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
	work involved in obtaining this information.					
17	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis Any deviation from the scope presented shall result in a corresponding adjustment (up or down) in the proposed pricing.	MARAFIQ asks bidder to list all the deviations in deviation form provided in RFP and bring to attention of MARAFIQ during the bidding stage. MARAFIQ shall not entertain any implication on cost related to deviations raised by bidder after award of the contract.	Noted	Partially complied and pending. Bidder has not provided consolidated list of all deviations, exceptions, assumptions, specific exclusions list considered for this proposed project. Provide consolidated list of all deviations, assumptions and exclusions.	Confirmed – bidder complies to SOW or Submits deviation sheet in line with RFP.	Complied and Closed. ARAFIQ ARAFIQ COURTENENT A ONTRACTS DEPT.
18	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54	Bidder to confirm grounding shall be provided as per MARAFIQ standards specifications and practice i.e MQ-SP-E-6001.	Confirm	Noted and Closed.	True continues de la contraction de la contracti	Complied and Closed



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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
	Proposal Basis					
	A common ground will be provided for both instrumentation and power grounding.					
19	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis 13. It is assumed the current cabling and field devices are in a good working order and compatible with the Mark VIe. Re-	Bidder shall confirm that internal panel wiring, associated field cable termination is part of SOW. Sensors and Field devices which are not compatible with new MARK-Vie systems shall be included in bidder's scope for replacement. Confirm sensors and field devices which are not compatible with proposed MARK-Vie up gradation shall be included in proposal for replacement including the associated cabling and conduits of those devices.	Confirm, however the existing instruments compatible with MK VIe are expected to be functioning, it will not be responsibility of M&C in case any proved malfunctioning.	Noted and Closed.		Complied and Closed

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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
	field devices is not part of Seller scope. 14. Replacement of any cabling or any field device determined bad are not part of this proposal.					
20	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis It is assumed the Buyer will provide the necessary power requirements to the Mark VIe per Seller standards.	Bidder to provide the details of the power supply required for proposed MARK-Vie system. Based on the power supply required for Mark-Vie, provide power consumption details.	One 110 or 220 VAC supply + One 125 VDC supply. Details of panel power consumption will be provided at engineering phase.	Noted and Closed.	Julia elino	Complied and Closed



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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dto 29.08.2015
21	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-54 Proposal Basis 19. Fifty (50) feet of Ethernet cable will be provided with each HMI. This is meant for limited networking needs and is not expected to cover all networking needs. Buyer is responsible for providing necessary networking cables. This includes the interconnecting Ethernet/fiber optic cabling and installation thereof	Bidder has excluded ETHERNET CABLES, FO cables required for extension of network in central control building CCB#13 for installation of EWS and Process Historian. Bidder to confirm ETHERNET CABLES, FO cables and switches for network extension shall be provided as EWS, Process Historian shall be installed in central control building CCB#13 which is situated approximately 500 meter away from Gas Turbines GTG building. Confirm.	Confirm, will include it by M&C sub-contractor as pet of turnkey scope	Noted and Closed.	Noted and Closed.	Complied and Closed

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Project: RFP Collective No. YNB-PR# 7000006947 Bidder: GE

GTG 1-8 Rehabilitations (GE PBC-I&C-001) Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dto 29.08.2015
	needed between					
	the PEECC where					
	the Mark VIe controller is					
	located and the					
	control room					
	where the optional					
	control room HMI					
	would be located,					
	should it be					
	purchased.					
	20. Up to fifty (50)					
	feet of Fiber Optic cable will be					
	provided with the					
	expanded/auxiliary					
	IO cabinet. This is					
	meant for					
	interconnecting					
	with the Mark VIe		ment 10 miles			
	cabinet. Buyer is responsible for		100 miles	Charles of the Control of the Contro		
	providing any			print the state of	110	
	necessary				Wolming Control	
	additional fiber		1	1.1	J.MAKA	1



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BID COMM	MENTS / CLARIFICATIONS
Project: RFP Collective No. YNB-PR# 7000006947	Bidder: GE
GTG 1-8 Rehabilitations (GE PBC-I&C-001)	Bidder's Ref: PROPOSAL # 778781-15-YGTZ Rev.0

S. No.	Reference in Bid Document	MARAFIQ comment (made prior to main bid submission)	Bidder's Response	MARAFIQ Response	GE Comments 8/27	Status MARAFIQ Response dtd 29.08.2015
	optic cables and installation. 21. No other interconnecting fiber optic cabling, Ethernet cabling, or any kind of cabling is included in this proposal except for the internal panel cabling.					









BID COMMENTS / CLARIFICATIONS

Project: RFP Collective No. PR7000006947 Bidder: GE

GTG 1-8 Rehabilitations.... Clarification # GE PBC-I&C-002

S. No.	Reference in Bid Document	MARAFIQ comments on 14 th July 2015	Bidder's Response on 10 th August 2015	MARAFIQ comments on 16 th July 2015	GE Comments 8/26	Status MARAFIQ Response dtd 29.08.2015
1	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-55 Proposal Basis No networking hardware, hubs, switches and routers other than those mentioned above in this proposal are provided.	Bidder to include network switches for network extension in CCB#13(Central Control Building) for installation of EWS and Process Historian. Confirm.	Noted. Will be included. Any Cables required for this Extension can be charged as per actuals during execution.	Partially complied and pending. Bidder to include firm charges of the cables in his proposal since this is an EPC contract. For estimate bidder can consider total length is 500metre for cables for network extension.	confirmed	Complied and Closed.
2	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-55 Proposal Basis No provisions for a separate integrated FAT or communication testing with DCS or other sub-systems are included in this proposal. Please note the only testing included in Seller's proposal is the customer witnessed FAT. Simple communication testing with the DCS and other subsystems can be conducted and verified by the GE field engineer carrying out the commissioning on site.	Bidder to confirm ABB Saudi Arabia shall be approached for interfacing and integration of upgraded Mark-Vie system to existing ABB DCS. Work shall include verification of existing MODBUS serial link, MODBUS register mapping details for data exchange with DCS including additional signal exchange of pressure transmitter and other devices as required.	Integration and interface with ABB DCS is included. Any Integrated FAT is excluded from GE scope of supply.	Complied and Closed.	Noted and Closed	Complied and Closed.
3	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-56 Proposal Basis b. Buyer's responsibilities Provide current revisions of unit drawings including: i. Turbine elementary ii. Interconnecting wiring diagram iii. Customers connection diagram	Bidder shall be responsible for retrieving of all existing drawings, documents, I/O list, Turbine Elementary, Interconnection Wiring Diagram, and Customer's Connection Diagram from MARAFIQ documentation Centre. MARAFIQ shall not be responsible for retrieving of all drawings and documents as requested. MARAFIQ shall extend help for mutual benefit. Confirm.	GE will do site walk to collect documentation as required. Customer need to arrange them to be readily available to collect.	Noted and Closed. Bidder shall be responsible and depute his personnel for research and retrieval of drawings and documents.	Noted and Closed	Complied and Closed. MARAFIO PROCUREMENT A CONTRACTS DEPT.
4	4.4 Speed Tronic from Mark V to Mark VIe upgrades	Bidder shall be responsible to arrange the analog telephone line for use by his field engineer. MARAFIQ is not responsible to provide any kind of utility including telephone, high speed	Noted, please refer to the DOR submitted as part of the Technical proposal for more details. Laydown area	Not complied and pending. Bidder's response is not clear and it is not in correct context. Bidder to provide copy of submitted DOR.	 Contractor will 	Complied and Closed.



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BID COMMENTS / CLARIFICATIONS

Project: RFP Collective No. PR7000006947

Bidder: GE

GTG 1-8 Rehabilitations... Clarification # GE PBC-I&C-002

Bidder's Ref: Proposal dated June 14 2015

Proposal Basis b. Buyer's responsibilities 4. Access to an analog phone line for use by the field engineer. 5. On-site sanitary facilities for use by the labor and field engineer(s). 6. Normal plant service required for maintenance such as light, heat, water, compressed air and electric power.	internet etc. All such required utilities shall be arranged by bidder not MARAFIQ for proposed project. The contractor is responsible to provide all requirements of utilities (Potable water, Electric, Telephone, Internet etc) connection to his site office and lay down area per SOW. This is deviation and not acceptable to MARAFIQ. The contractor shall arrange the Mobile Generator of required capacity for power supply. The Contractor shall arrange the portable Compressor of required capacity for this project. Site office may be located away from the actual GTG plant. So contractor has to arrange the mobile compressor at his own cost. Refer the SOW page-23, SECTION – III TECHNICAL REQUIREMENTS, Mobilization and demobilization The Contractor is responsible to arrange amenities and facilities required by his personnel including temporary facilities. MARAFIQ will not provide amenities, facilities as listed. MARAFIQ will provide space for contractor's site office,	has already allocated as per site visit with Marafiq maintenance team.		1. Phone line / internet 2. all requirements of utilities 3. Mobile Generator 4. Portable Compressor 5. Site Facilities	
4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-56 Proposal Basis b. Buyer's responsibilities 11. Provide all required installation tools and materials. 12. Provide all tools, instrumentation and equipment necessary to safely and accurately commission the equipment.	Bidder to refer section-II, General Requirements of SOW which clearly states the contractor's responsibilities. Refer Page-20 of SOW, Commencement and completion of work. Bidder shall be responsible to provide all required installation tools and materials required for the proposed project. This is a EPC contract. As an EPC contractor, bidder shall arrange and equip himself all required tools for installation, testing and commissioning. MARAFIQ is not responsible to provide installation tools and materials. Confirm. Bidder shall be responsible to provide all tools, instrumentation and equipment necessary to safely and accurately commission the equipment for the proposed project. This is a EPC contract. As an EPC contractor, bidder shall arrange and equip himself all required tools for installation, testing and commissioning. MARAFIQ is not responsible to provide installation tools and materials. Confirm.		Complied and Closed. MARAFIQ will extend all the help to contractor for mutual benefit.	Noted and Closed	Complied and Closed.







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(4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-56 Proposal Basis b. Buyer's responsibilities Provide any remote operator interfac or DCS connections	Bidder shall be responsible for providing remote operator interface of EWS and Process Historian and Interface to DCS per RFP. MARAFIQ shall not be responsible for providing remote operator interface or DCS connections. Bidder shall approach ABB Saudi Arabia for DCS interfacing and integration requirements.	GE will include Remote EWS, Historian in scope of supply. Interface with DCS is included from ABB. All cables required for Remote interfaces like Fiber optic/Ethernet cables excluded from GE scope of supply.	Partially complied and pending. Bidder to include all cables required for Remote interfaces like Fiber optic/Ethernet cables in his scope of supply. Bidder to consider total length of 500 metre for remote interfaces for Fiber Optic/Ethernet Cables and accordingly provide firm quote in his proposal.	confirmed	Complied and Closed.
. 0	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-56 Proposal Basis b. Buyer's responsibilities Schedule and manage allotted Specialists' hours for best utilization is overall project schedule. Additional hours will be considered extra work.	Bidder shall be responsible to schedule and manage the specialist hours for best utilization. MARAFIQ is not responsible for any extra hours' effort incurred by specialist since this is an EPC contract. Confirm. As per RFP, Scope of Supply (Services & Materials), supply of specialist skilled professionals falls under the responsibility of bidder not MARAFIQ. Refer Section-III Technical Requirements, General scope of services, Page-23	Noted. However, any delay caused by non-GE and its subcontractors cause shall be charged to Marafiq (ex. Inspections delay, testing delaysetc)	Noted and closed.	Noted and closed	Complied and Closed.
	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-56 Proposal Basis b. Buyer's responsibilities Provide access to latest revised plant drawings necessary for checkout, start-up and commissioning of the equipment.	MARAFIQ will extend all help for mutual benefit. However bidder shall be responsible for retrieval of required latest drawings and documents for check out, start-up and commissioning of the equipment. Confirm.	Noted. Customer need to make arrange documents ready to retrieve.	Noted and Closed. Bidder shall be responsible and depute his personnel for research and retrieval of drawings and documents.	Noted and closed	Complied and Closed.
J.	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-56 Proposal Basis b. Buyer's responsibilities Provide qualified personnel for instrument calibration and to assist in functional testing of the equipment.	Bidder shall be responsible to hire qualified staff/personnel for instrument calibration and to assist in functional testing of the equipment. MARAFIQ is responsible only to witness the calibration and functional testing. Since this is an EPC Contract, bidder shall arrange qualified staff including latest calibration equipment like pressure calibrator, multi-function calibrator for loop functional testing and commissioning. Confirm.	Calibration included only for new Transmitters. Existing Instrument recalibration is excluded	Complied and closed.	Noted and closed	Complied and Closed.
1	4.4 Speed Tronic from Mark V to Mark Vie upgrades Page-56 Proposal Basis b. Buyer's responsibilities	MARAFIQ will extend all help for mutual benefit. However bidder shall engage all required professionals and specialist for startup and commissioning.	Arranging operators during startup is customer's responsibility.	Noted and closed.	Noted and closed	Complied and Closed.









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12	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-57 Proposal Basis	MARAFIQ will extend all help for mutual benefit. However bidder shall be responsible for retrieval of required latest drawings and documents for check out, start-up and commissioning of the equipment. Confirm.	Ok noted	Noted and closed.	Noted and closed	Complied and Closed.
11	Expectations prior to the startup support arrival on site are as follows: i. All signal and power cables for the control system shall be installed, terminated, and fully electrically tested. ii. A permanent source of power to all control panels shall be available and energized. iii. All interconnecting communication cabling including fiber optic cabling shall be installed and terminated. iv. Locations identified for all network equipment (switches, media converters, etc.). v. Final location for computers, monitors, and printers identified. vi. Reliable power available for all computer and network equipment. vii. Any conduit required to interconnect computer and network equipment shall be in place. viii. A dedicated startup person shall be available to GE Specialist to assist in IO checkout.	 i. Bidder shall be responsible for testing of signal and power cables for the control system. Confirm. ii. Noted. iii. Bidder shall be responsible for interconnection and termination of communication cables including fiber optic cable. Confirm. iv. Noted. v. Noted. vi. Noted. vii. Bidder shall be responsible for conduiting work including the required material. viii. Noted. MARAFIQ will provide dedicated person and extend all help for mutual benefit. 	i. Confirm ii. Noted iii. Confirm iv. Noted v. Noted vi. Noted vii. Noted viii. noted	i. Noted and closed. ii. Noted and closed. iii. Noted and closed. iv. Noted and closed. v. Noted and closed. vi. Noted and closed. vii. Noted and closed. viii. Noted and closed.		
	duration of start-up and commissioning. 4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-56 Proposal Basis b. Buyer's responsibilities				Noted and closed	Complied and Closed.









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	b. Buyer's responsibilities					
	In order to initiate and complete the engineering of these modifications the following documentation will be required from the Buyer: As-running Turbine, Generator, and Motor Control Center controls elementary diagrams					
	② As-running device summary diagram					
	As-running controls specifications					
	As-running connection diagram					
	Electrical One Line diagram					
	As-running piping schematic diagrams					
	☐ Generator Reactive Capability Curve					
13	4.4 Speed Tronic from Mark V to Mark VIe upgrades Page-57 Proposal Basis b. Buyer's responsibilities It is assumed no hazardous material will be encountered in performing the work scope. Disposal of any hazardous or regulated material will be the responsibility of the Buyer.	Bidder shall be responsible for safe disposal of any hazardous material generated during execution of the project. MARAFIQ is not responsible for disposal any hazardous material generated during execution of the project. Safe disposal of hazardous material shall be in accordance with Royal Commission Guideline and procedure.	Noted. However, since Marafiq owns all equipment, Marafiq ID might be requested by local authorities for disposal of some items and hence, please confirm.	Noted. Bidder to follow RCER -2010 for safe disposal of hazardous waste generated during construction. Confirm.	Confirmed Bidder will RCER-2010 and all applicable local laws and regulations, without title transfer to waste generated.	Complied and Closed.
14	4.15 Hydrogen Control Panel	Bidder has not submitted the proposal for Hydrogen Control panel of Generator. Bidder to confirm the compliance of SOW for " 1.15 Hydrogen Control Panel MARAFIQ asks bidder to submit the technical proposal including brochures, technical catalogues, sow, drawings, etc applicable for this project.	GE has approached Yokogawa for this scope considering their good experience with Marafiq in the previous project (2010-2011). Complete technical proposal with compliance sheet will be submitted to Marafiq once received. Optionally this could be eliminated if Marafiq considers full generator replacement (Air Cooled)	MARAFIQ asks bidder to submit the proposal for Hydrogen Control Panel. The proposal was not submitted and MARAFIQ is not able to proceed for technical evaluation.	Please find attached technical details	Complied and Closed.









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					J-	
					GD analyzer.pdf FOF Typical Hydrogen	
					Control Drawing .pdf Typical Purge Control Drawing .pdf	
15	4.16 Replacement of AVR by digital Excitation system It is customer's responsibility to either remove the current system or simply not use the system, but provide adequate space for the system offered by GE.	Bidder's stated work for removal of current system by MARFAIQ is not acceptable. Bidder shall arrange to remove all parts of existing excitation system which are being replaced with new excitation system. How can MAARFQI remove the existing excitation system and new one bill be supplied by bidder. Removal of existing excitation system and installation of new excitation system is in bidder's scope.	Bidder will remove existing static excitation system. Rotating parts will not be removed so not to disturb generator rotor weight inertia.	Noted. Bidder to submit the technical feasibility for proposed static excitation system. MARAFIQ shall decide to select the type of excitation system based on feasibility report.	Existing excitation on units 1 to 8 are multistage static and rotating excitation system. This is a very old system with many dis-advantages. Each section adds time constant to overall response of the generator to network transients. GE recommends the following options; 1) change entire system to static, 2) change the generator completely to new Brushless system with only one rotating stage. GE recommendation is to go with #1 if existing generators are to be maintained or 2 if existing generators are being replaced with new brushless generators.	
16	4.16 Replacement of AVR by digital Excitation system Placement of the new PPT and connections to generator Aux Bus or to exciter is not included in this offer. This would be in scope of contractor.	Bidder shall include to install and making new connection to PPT in his proposal. Bidder shall arrange and co-ordinate with his sub-contractor to carry out all the work. Bidder shall be EPC contractor for MARAFIQ. Please clarify the meaning of "This would be in scope of contractor" MARAFIQ understands this would be either in bidder's scope or his sub—contractor not in MARAFIQ's scope.	Bidder will install the new excitation and PPT system and connect the PPT secondary to exciter and from there to generator rotor. However, PPT primary connection to generator terminals will not be in bidder's scope till customer (Marafiq) submits ALL the existing generator BUS design drawings and details so bidder can estimate bus cost and bus tapping. Bidder will NOT be able to find all these details by site walk. Bus design details and drawings must be provided to bidder before then can include that part in their scope.	Partially complied and pending. MARAFIQ has provided all the drawings and documents to bidder. Confirm bidder shall include making of primary connection of PPT to generator terminals in his scope.	Confirmed – Bidder will include Primary Connections of PPT.	Complied and Closed









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17	4.9 Replacement of AC/DC Power, Control & Instrumentation Signal Cable	Bidder has not provided technical proposal including brochures, catalogues and preliminary SOW description. Bidder to confirm the full compliance of SOW for Replacement of AC/DC Power, Control & Instrumentation Signal Cable per RFP with no deviations.	Due to in-complete bid information about this scope and as per Marafiq agreement before the technical bid submittal, GE will provide unitary price for each cable type/size beside a lump sum price for routing and necessary accessories.	Not complied and pending. MARAFIQ has provided all the drawings and documents including cable schedules. What are other documents which have not been provided to bidder? Since this is and EPC contract, bidder shall provide firm quote in his proposal.	Confirmed – Bidder will replace per RFP	Complied and Closed.
18	4.11 Replacement of GTG Exhaust Shut off and by pass damper Geared motor	Bidder has not provided technical proposal including brochures, catalogues and preliminary SOW description. Bidder to confirm the full compliance of SOW Replacement of GTG Exhaust Shut off and by pass damper Geared motor per RFP with no deviations.	Pls see attached full details about all Exhaust Scope. Exhaust Offering Details	Bidder should understand the comments as per SOW the Bidder shall supply and Install the Shut off and By pass Damper Geared motor to suit our Existing setup.	Confirmed – Bidder will supply Shut off and By pass Damper Geared motor to suit the Existing setup	Complied and Closed.
19	4.14 Generator Breaker Replacement	Bidder has not provided technical proposal for 4.14 Generator Breaker Replacement. Bidder stated the scope is being reviewed by ABB and it will be submitted at late stage. MARAFIQ asks bidder to submit complete technical proposal for Generator Breaker Replacement including technical catalogues, brochures, preliminary SOW description, BOM per RFP.	Still Pending. GE is considering Alstom as well since they have done two GCBs already at Marafiq site for two units. Proposal is being reviewed and will be submitted to Marafiq accordingly	Not complied and pending. Please submit proposal for technical evaluation.	Specifications are being provided in GE-PBC-EE-001 item 27. Kindly request to follow that section and consider closed in I&C-002. Repeating EE-01 item 27 For your reference:	
20	4.16 Replacement of AVR by digital Excitation system Page-117 OTHER Additional requirements or Seller's Site Survey results may necessitate the design and installation of additional scope of supply and a corresponding adjustment to the pricing and delivery as presented.	Bidder has visited the site and MARAFIQ provided all the drawings as requested. Bidder shall verify the existing design of excitation system of GTG init1-8 and GTG-9. Accordingly bidder shall propose additional scope for excitation system replacement work if required and shall revise his proposal before award of the contract. MARAFIQ shall not accept the revision of proposal on account of site survey results and design necessity after award of the contract.	estimate the cost for bus work. Hence, bus work will be considered during design work.	Partially complied and pending. MARAFIQ has provided all the drawings and documents to bidder. Confirm bidder shall include making of primary connection of PPT to generator terminals in his scope.	Confirmed – Bidder will include Primary Connections of PPT.	Complied and Closed
2	4.16 Replacement of AVR by digital	Bidder has proposed FAT (Factory Acceptance Test)/witness test as an optional for one unit. This is not acceptable. Bidder to include FAT (Factory Acceptance Test) of EX2100e unit in base proposal. All FAT expenses including transportation, air	This can be included per Marafiq requirement. Please specify how many integrated FATs are required and how many customer personnel will be witnessing the FAT so bidder can calculate all expenses cost in their bids.	Partially complied and pending. Minimum two integrated FAT tests are required. Four personnel shall witness the test. MARAFIQ ask bidder to include minimum two FAT	Two Integrated FAT test, each with Four People is now included, Transportation roundtrip Air tickets from Yanbu, KSA to FAT location	Complied and Closed.









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		fare, lodging, boarding charges for MARAFIQ employees shall be borne by bidder and shall be included in base proposal. Bidder to confirm the FAT of EX2100e shall be conducted as an integrated FAT test with Mark-Vie control system.		Tests to be witnessed by four personals.	and also Lodging and Local transportation will also be included. (anything additional like health insurance, medicare, long distance calls, Hotel pay TV channels, laundry, etc. are excluded)	
22	4.16 Replacement of AVR by digital Excitation system 4.16.7 Scope of Supply, a. BOM PSS (Power System Stabilizer Studies) PSS tuning study	Bidder has included PSS system analysis study to determine the required configuration parameters settings. Bidder to confirm proposal includes provision of any new inputs and field devices required to provide as an outcome of PSS system analysis study and PSS tuning study. PSS system analysis study and PSS tuning study shall be performed though software simulation of generator performance.	Bidder's PSS tuning studies will incorporate all the devices on the customer's site as per the details provided by the bidder.	Complied and closed.	Noted and closed	Complied and Closed.
23	4.16 Replacement of AVR by digital Excitation system b. EX2100e Exciter Hardware Please note, It is contractor's responsibility to make sure above space is available to replace the existing systems on units 1, 2, 3, 5, 7, & 8 Also space needed for the new PPTs	Bidder shall be responsible to ensure the new Excitation unit will be accommodated in existing available space occupied old excitation system. Confirm retrofitting of EX2100e Excitation Control System shall be bidder's responsibility. Bidder has mentioned contractor shall be responsible to verify the space availability for installation of new excitation system. MARAFIQ shall not be responsible for installation of new excitation system in existing space. Bidder (EP)C Contractor) and his sub-contractor shall take thorough responsibility to verify the available space for new excitation system.	This is a difficult task. Existing exciters for units 1 to 8 are combination of static and rotating. On top of that, bidder's spec is calling for full redundancy in controls and bridges which makes the new exciter much bigger in size. Same for unit 9. Existing is not redundant so bidder can easily replace existing one with new non-redundant exciter. But for new one to be fully redundant, it will obviously be larger than the existing one which is not redundant. So foot space is not going to be the same. Bidder expects customer to either relax their spec for calling redundant system or provide space for redundant system. Existing system is simplex. Espec calls for redundant system which will be larger than existing system. Naturally we'd need more space and customer must provide that space or accept non-redundant system which will have no space issue.	Not complied and pending. This response is contradicting with GE's own response given in GE-PBC-EE-001 dt.4 Aug.2015, wherein they have stated as, 'As stated by GE, new Static exciter will be placed in same room and in same place as the existing excitation system. The control portion of new exciter will not be in the same lineup as new exciter will be wider by existing exciter. But upon our site survey, the same room where the existing exciter is located does have space for exciter control enclosure. So there are no issues with space for the new Exciter.' GE to clarify the discrepancy in their two different replies, and reconfirm space availability for the offered Excitation System, without any dilution or deviation from specification requirements.	To clarify: there is no space issue on replacing excitation units 1 to 8. For unit 9, since we're changing a simplex unit with a full redundant system, we'd need more space. But the required space is small as it is for an AVR only. We'd need space for 800mm wide by 800 mm deep enclosure.	Complied and Closed.
24	4.16 Replacement of AVR by digital Excitation system	Confirm the cell size of new excitation system of GTG unit-1, 2,3,5,7 &8. There is ambiguity in proposal at one place bidder has mentioned 77mm cell size at other places 53,77mm cell size.	Confirmed. We'll take the 53 and 77mm reference out of proposal so to reduce confusion. Cell design will be after receipt of the order.	Complied and Closed.	Noted and closed	Complied and Closed.









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25	4.16 Replacement of AVR by digital Excitation system	Bidder has proposed retrofitting of EX2100e for GTG units 1, 2, 3,5,7,8 and 9. MARAFIQ asks bidder to include retrofitting of EX2100e for GTG units 4 and 6 also in base proposal. Confirm.	Confirmed. This is different than what originally been requested. Units 4 and 6 will be included in GE scope and that is actually recommended to change all units at the same time so to get benefits of all new integrated control system.	Complied and Closed.	Noted and closed	Complied and Closed.
26	4.17 Installation of Ventilation fan & hydrogen detectors inside DCC	Bidder has not provided technical proposal including SOW (Brief scope of Work Description), BOM, technical catalogues, and brochures for the major equipment for INSTALLATION OF HVAC SYSTEM & HYDROGEN DETECTOR INSIDE DC COMPARTMENT FOR GTG UNITS 1-8. MARAFIQ asks bidder to submit technical proposal for Installation of Ventilation fan & hydrogen detectors inside DCC. Technical proposal enables MARAFIQ to evaluate. In the absence of technical proposal for installation of HVAC and Hydrogen Detectors for DC compartment, MARAFIQ cannot evaluate the proposal. MARAFIQ asks bidder to comply the requirement.	Pending, Optionally this could be partially eliminated if Marafiq considers full generator replacement (Air Cooled)	Not complied and pending. Bidder to submit proposal for all items included in base proposal. Bidder can propose Air Cooled Generator and other stuff as an alternative offer or optional item. MARAFIQ will study and accordingly bidder shall be notified for the final decision. Bidder to provide response.	Bidder confirms including in the base scope.	Complied and Closed.
27	4.18 Motor Control Center Replacement 4.18.6 Exclusions 12. Supply of any Power cables specifically for this scope under this line item. 13. Any civil work not related to the scope. 14. Travel & Living (T&L) expenses and daily allowance of End User/Buyer during FAT/Training in factory. 15. Any other replacement parts not related to sellers scope 16. Supply of any CTs or PTs and it services not covered in the BOM 17. Scheme modification work. 18. Reproduction of existing drawings.	Bidder has stated exclusions for MCC replacement. This is totally unacceptable. As stated in SOW SECTION — IV Q, REPLACEMENT OF MCC FOR GTG 1-7, bidder has to comply all the requirements of SOW.	Noted. Full deviation list will be submitted per Marafiq sheet.	Partially complied and pending. Bidder to provide response.	Bidder will comply with SOW requirements per RFP.	Complied and Closed.
28	4.19 Gas Flow Meter Replacement	Bidder has proposed Coriolis mass flow meters for blended unit and LNG unit. This project is for GTG rehabilitation. There is no blending and LNG facility. We understand this is typo mistake. Bidder to confirm. Bidder has proposed Coriolis flow meter for measurement of gas flow to each GTG. This is deviation per SOW. SOW specifies orifice based flow meter not Coriolis mass flow meter as proposed by bidder.	Pending	Not complied and pending. Bidder to provide response.	Please find attached additional details on the Coriolis which is GE's recommendation as it provide higher accuracy and reliability over the orifice flow meter.	Complied and Closed.







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		As per ARAMCO Standard SAES-Y-101, orifice based flow meter is required type of flow meter for the GTG flow rate. Bidder has to justify the selection of the proposed flow meter. ARAMCO Standards SAES-Y-101 specifies either orifice or multipath ultrasonic based flow meter for sales gas metering application. Bidder to provide justification why he has proposed Coriolis flow meter and not proposed either Orifice or Multipath Ultrasonic Flow meter.			Coriolis Flow Meters.pdf It Also provides higher flexibility for interface with HMI.	
		Bidder to confirm acceptance/rejection of Coriolis mass flow meter shall be solely based on the MARAFIQ decision.				
		Bidder has not provided technical catalogues, brochures, brief scope of work description and BOM of Replacement of gas flow meter and other field devices per RFP SOW SECTION – IV R, REPLACEMENT OF GAS FLOW METER & OTHER FIELD INSTRUMENTS FOR GTG UNITS 1-9				
		Provide the technical catalogues, brochures of proposed Coriolis mass flow meter.				
		Confirm proposal includes piping modification required for installation of Coriolis Flow meter.				
	4.19 Gas Flow Meter Replacement The Coriolis gas mass flow meters	Bidder has proposed Coriolis flow meter which measure mass flow. MARAFIQ has specified orifice flow meter for volumetric flow measurement. How bidder will comply this requirement? Only through calculation or some other means per AGA -11 and AGA-8 is acceptable. What is the uncertainty level expected from mass flow to volumetric conversion of flow rate?		Not complied and pending. Bidder to provide response.	Please find attached additional details (item 28) on the Coriolis which is GE's recommendation as it provide higher accuracy and reliability over the orifice flow meter.	Complied and Closed.
29	provide a direct mass flow measurement to the MK VI via a 4 – 20 mA signal and have a measurement accuracy of +/- 0.5%.	As per contract with gas provider (ARAMCO), volumetric flow rate at standard conditions is required for consistency in reporting. Bidder to include live pressure and temperature measurement for compensated flow. Confirm proposal includes live pressure	Pending		It Also provides higher flexibility for interface with HMI. Confirmed, each flow meter to have live pressure and	
		and temperature measurement for each flow meter.			temperature measurement.	
30	4.19 Gas Flow Meter Replacement The Coriolis gas mass flow meters provide a direct mass flow measurement to the MK VI via a 4 – 20 mA signal and have a measurement accuracy of +/- 0.5%.	Bidder has proposed only Coriolis flow meter. What about flow computer? Why bidder has not proposed flow computer? Coriolis Flow meter will be interfaced to mass flow computer to derive volumetric flow rate at standard conditions. Flow computer additionally performs the alarming, audit trail logging, historical data logging, calibration and security functions.	Pending	Not complied and pending. Bidder to provide response.	Please find attached additional details (item 28) on the Coriolis which is GE's recommendation as it provide higher accuracy and reliability over the orifice flow meter.	Complied and Closed.









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BID COMMENTS / CLARIFICATIONS

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		Confirm proposal includes flow computer with each Coriolis Flow meter for each Gas Turbine Generator for proposed GTG rehabilitation project.			It Also provides higher flexibility for interface with HMI. MkVIe will have the computed flow measurement, which will be displayed on the HMI.	
31	4.19 Gas Flow Meter Replacement	Bidder has not provided brief description of scope of work, catalogues, brochures and BOM for Gas flow meter replacement and other field instruments.	Pending	Not complied and pending. Bidder to provide response.	Please find attached additional details (item 28) on the Coriolis which is GE's recommendation as it provide higher accuracy and reliability over the orifice flow meter. It Also provides higher flexibility for interface with HMI.	Complied and Closed.
32	4.4 Speed Tronic from Mark V to Mark VIe upgrades Reuter Stokes Flame Detectors	Bidder to confirm new Reuter Stokes Flame Detectors shall be minimum SIL 2 compliance. Provide the brochures, technical catalogues of Reuter Stokes Flame Detectors.	SIL2 compliance for Flame detectors not available.	Noted.	Noted and closed	Complied and Closed.
33	4.4 Speed Tronic from Mark V to Mark VIe upgrades	Bidder has not proposed in his proposal for buyback offer of Mark-V hardware which will be replaced. Please include buyback of existing hardware as an optional item. Rebate on existing Mark-V Systems under buy back scheme. MARAFIQ requests bidder to go through the existing system details. Accordingly, Bidder must indicate the rebate offered on the existing system.	Noted.	Partially complied and pending. Confirm proposal includes the buyback of existing Mark-V hardware as an optional item or not.	This Option will be part of the Commercial Proposal	Complied and Closed.











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Bidder: GE

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S. No.	Reference in Bid Document	MARAFIQ comment on 28th July 2015	Bidder's Response on 12th August 2015	MARAFIQ comment on 18 th August 2015	GE Comments 8/26	Status MARAFIQ Response dtd 29.08.2015	GE Comments 10/13	MARAFIQ Response dtd 14.10.2015	GE Response 29 OCT 2015	Marafiq Response 02 Nov 2015
1.	Cooling Water Radiator Skid	Instrumentation and control scope of work not mentioned. Signal interfacing with mark 6e and Tenore NT should be GE SOW.GE should agree Marafiq SOW. GE has mentioned 4 FD Fans but Marafiq SOW mentioned only 3 FD Fans, GE need to clarify it.	GE is going to design and size the cooling water module and system based on the site conditions present at Marafiq.	Partially complied. Pending. Bidder to confirm to follow SOW for compliance	Bidder will comply with SOW As per the design, 5 out of the 6 fans are operational and the 6th is on standby, the 6th fan will redundant per module. Each module is capable of cooling 1,200 gpm of 20% Ethylene Glycol / 80% Water from 172.79°F to 148°F while rejecting 14,200,000 BTU/hr at an ambient of 140°F.	Complied and Closed.		Complied and Closed.		Complied and Closed.
2.	NO'x Control System	GE has to comply Marafiq SOW and submit all the drawings. GE has not included CEMS installation, It has to be installed by GE.	Was the CEMS system required for validating the NOx emissions? If this is needed, GE can do it.	Separate, dedicated CEMS system is not required proposed project. At present separate project for PEMS execution is going on for GTG. PEMS shall be utilized to validate NOx emission. However bidder can hiring of mobile CEMS to validate NOX emission to comply the Performance test.		Complied and Closed.		Complied and Closed.		Complied and Closed.
3	NO'x Control System-Water injection	GTG#9 having water injection system, the system was not in service for many years due to the obsolete of Humidity sensor.GE has to supply the humidity sensor and also commissioning of the water injection system, since our gas fuel was changed from Ethane to Methane.	GTG9 was out of GE scope. Marafiq to send GE detailed scope for GTG9 requirements.	Noted. MARAFIQ shall provide the details as requested by bidder. GE had designed, supplied, installed, tested and commissioned GTG-9 Water injection skid. GE should know the water injection skid. Functional description of water injection skid is attached here.	Noted awaiting details from Marafiq	Noted. MARAFIQ has already forwarded the details to bidder.	Confirme d receipt of the details requeste d		Confirmed , supply and install new Humidity sensor and commissio ning of new Humidity sensor	Complied and Closed.



Bidder: GE Project: RFP Collective No. PR7000006947

GTG 1-8 Rehabilitations.... Clarification # GE PBC-1&C-003

] 4	NO'x Control System	Marafiq Engineering team (TSD) has to decide either we should go for Water injection or DLN1 burner.	The NOx levels are different for gas fuel operation. Although Marafiq calls for meeting 80ppm, with water injection the NOx can be down to 42ppm, while for DLN 1 the NOx is capable to 15 ppm without water injection. Please note that liquid fuel operation still requires water injection to meet NOx emissions.	Noted.	Noted	Complied and Closed.	Complied and Closed.	Complied and Closed.
]	On Page no. 55 mention that All network cables (Ethernet, optical fiber) are limited to 50 feet only and HMI graphical	All network cable (Ethernet, optical fiber) should not limited to 50 feet only, GE has to supply network cable whatever length required. HMI graphical display should not limited to 20, GE should provide all required HMI pages. Permit will be	All cables scope including Fiber optic and Ethernet are excluded from GE scope of supply and can be priced separately. Control and Power cabling for DCS interface are also excluded from GE base scope of supply and can priced optionally. HMI screens are from standard GE library screens only If Marafiq has extended customization, need	Exclusion of fiber optic and Ethernet cables are not acceptable at all. Bidder shall include FO and Ethernet cable in his scope considering the maximum distance between GTGs and Central control room including all routing shall be maximum 500 metre for network extension from GTG building to Central Control Room. Since this is an EPC contract, bidder shall include design, supply, install, test and commission of FO and Ethernet cables in his scope including as lump sum. Bidder to provide firm quote for FO and Ethernet cables.		Complied and Closed.	Complied and Closed.	Complied and Closed.
	displays are limited to 20 only A Report 1147. 1010223377 1.1. YYYYYY	required HMI pages. Permit will be GE responsibility. GE has to contact ABB Italy for DCS interfacing. Control and power cable also need to be replaced by GE.	to be quantified.	Exclusion of control and power cable for DCS interface are not acceptable at all. Bidder shall include control and power cable in his scope as a lump sum. Since this is an EPC contract, bidder shall include design, supply, install, test and commission of control and power cable in his scope including as lump sum. Bidder to provide firm quote for control and power cable.		Complied and Closed.	Complied and Closed. S. MARAFIO PROCUNENCIA PROCUNENCIA CONTRACTS DEPT.	Complied and Closed.







Project: RFP Collective No. PR7000006947

GTG 1-8 Rehabilitations.... Clarification # GE PBC-I&C-003

				Bidder to confirm to develop, configure graphic display screens (dynamic displays) for each GTG including the customization of graphic as required not limited to 20 (twenty) only.	Bidder will comply	Complied and Closed.	Complied and Closed.	Complied and Closed.
6	On Page no. 55 mention that No other interconnecting fiber optic cabling, Ethernet cabling, or any kind of cabling is included in this proposal except for the internal panel cabling.	Interconnecting fiber optic cabling, Ethernet cabling, or any kind of cabling may be required for interfacing of mark 6e with ABB DCS, So GE has to provide that if required.	Noted	This response is contradicting with GE's own response given for item no. 5 of Clarification # GE PBC-I&C-003.	Bidder will comply	Complied and Closed.	Complied and Closed.	Complied and Closed.
7	On page no. 56 mention that Provide all tools, instrumentation and equipment necessary to safely and accurately commission the equipment.	It should be GE SOW.	Confirm	Complied and Closed.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
8	On Page No.38 Index last column not clear to understand	What does it mean by no. of mobilization to site	Number of Field service personnel mobilizations. This is just for Marafiq information however it will be part of the project management plan.	Noted.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
9	On Page no. 54 mention that A common ground will be provided for both instrumentation and power grounding	GE should provide separate ground for instrumentation and power.	Noted	Noted.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
10	On Page no. 54 mention that DLN tuning is to be performed by others.	DLN tuning has to perform by GE representative.	Confirm	Complied and Closed.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
11	On Page no. 54 mention that The wiring database provided by Seller does show the field wiring connections to the Mark VIe terminal boards	After installation of Mark Vie the Wiring drawing details and field interface drawings are to be provided by GE	Noted, will be provided	Complied and Closed.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
12	On Page no. 54 mention that Replacement of any cabling or any field device determined bad are not part of this proposal	Marafiq SOW mention that Replacement of AC/DC power ,control and instrumentation signal cable should be GE SOW,GE has to agree Marafiq SOW.	Noted	Complied and Closed.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
13	GE mention that Toolbox St will be installed in engineering station only	Toolbox St must be installed in all HMI for GTG 1-9 so it will be easy for maintenance and troubleshooting	Ok Confirmed.	Complied and Closed.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.









Project: RFP Collective No. PR7000006947

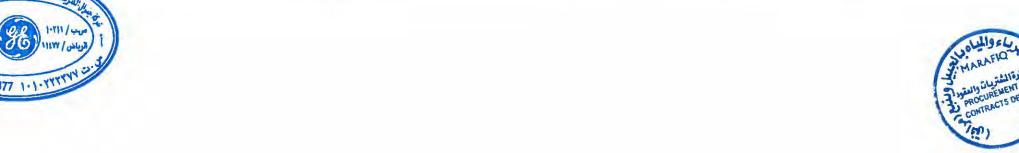
Bidder: GE

GTG 1-8 Rehabilitations.... Clarification # GE PBC-I&C-003

Bidder's Ref: Proposal dated June 14 2015

14	Replacement of Mark 5 with Mark 6e	GE has to hand over all Mark 5 hardware in good condition with proper handling without damaging	Noted.	Complied and Closed.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
15	On page no. 44 GE proposed Reuter Stokes Flame Detectors	The newly offered Flame scanner by GE is acceptable for GTG 1 to 9.	The new flame detector included in the proposal are Flame Tracker Dry (water is not required for cooling)	Noted.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
16	On page no. 45 GE mentioned That Conduit changes may be required for New Reuter Stokes Flame Detectors. Conduit changes are site-specific and the customer will be responsible for any new junction boxes	The replacement of conduit and JB for flame scanners by GE scope not by Marafiq.	Yes, the interconnection with the control panel is included as part of the scope.	Complied and Closed.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
17	Replacement of Mark 5 with Mark 6e	Page: 34: GE proposed two types of controls 1) Mark VIeS 2) Mark Vie. Mark Vie S for TMR controls that is GTG#9 GTG 1 ~8 Mark VIeS SIL system is not applicable for simplex controls, and proposing validation method to check. In this case Marafiq TSD opinion required.	Noted.	Noted.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
18	On page no. 50 GE Scope added one more RVDT for IGV	Our existing GTG's having 2 RVDT's for IGV, whereas GE Scope added one more RVDT. What is the purpose and where it is going to be connected in the field.	GE has included only one RTD per IGV per unit.	This response is contradicting with GE's own response given in GE-PBC-I &C -001 dtd. 1st Aug.2015, item no. 6. GE has stated in earlier response that RVDT shall not be replaced. Why? GE has to provide justification why only one RVDT be replaced not two (2). IF GE shall not replace existing RVDTs of IGV, GE shall provide justification.		Complied and Closed.	Complied and Closed.	Complied and Closed.
19	On page no. 54 GE mentioned that All demolition/installation/commissio ning manpower and materials not mentioned in this Proposal are not part of the Seller's scope of work.	All demolition/installation/commissionin g manpower and materials required for this project should be GE SOW	Confirm as per the final agreed scope.	Complied and Closed.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.





4 | Page



Project: RFP Collective No. PR7000006947

GTG 1-8 Rehabilitations.... Clarification # GE PBC-I&C-003

Bidder: GE

Bidder: Ref: Proposal dated June 14 2015

20	On page no. 54 GE mentioned that Re-calibration or replacement of field devices is not part of Seller scope.	Since the controllers are being replaced so commissioning and verifying the field signals inputs and outputs by GE and also calibration and adjustment of field control valve GCV/SRV/IGV and LFO system by GE.	Only Re calibration of Transmitters are excluded. Verification of Signals and Calibartions of Valves included.	Noted.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
21	On page no. 54 GE mentioned that It is assumed the Buyer will provide the necessary power requirements to the Mark VIe per Seller standards.	GE Shall provide us power requirement for Mark VIe	GE can provide Power requirements for MarkVie to Marafiq.	Noted.	Noted and Closed	Complied and Closed.	Complied and Closed.	Complied and Closed.
22	4.9 Replacement of AC/DC power ,control and instrumentation signal cable	GE should agree Marafiq SOW	Pls refer to clarification number GE-PBC-I&C-002_R1_GE point # 17 for the reply	Not complied and pending. MARAFIQ has provided all the drawings and documents including cable schedules. What are other documents which have not been provided to bidder? Since this is and EPC contract, bidder shall provide firm quote in his proposal.	Confirmed – Bidder will replace per RFP	Complied and Closed.	Complied and Closed.	Complied and Closed.
23	4.15 Hydrogen control panel	No proposal submitted by GE	Pls refer to clarification number GE-PBC-I&C-002_R1_GE point # 14 for the reply	Not complied and pending. MARAFIQ asks bidder to submit the proposal for Hydrogen Control Panel. The proposal was not submitted and MARAFIQ is not able to proceed for technical evaluation.	GE-PBC-I&C- 002_R1_GE point # 14, was updated with technical details about the Hydrogen control panel, please refer to files attached therein.	Complied and Closed.	Complied and Closed.	Complied and Closed.
24	4.17 Installation of ventilation fan and hydrogen detectors inside dcc	No proposal submitted by GE	Pls refer to clarification number GE-PBC-I&C-002_R1_GE point # 26 for the reply	Not complied and pending. Bidder to submit proposal for all items included in base proposal. Bidder can propose Air Cooled Generator and other stuff as an alternative offer or optional item. MARAFIQ will study and accordingly bidder shall be notified for the final decision. Bidder to provide response.	GE-PBC-I&C- 002_R1_GE point # 26 is being updated please refer to files attached therein.	Complied and Closed.	Complied and Closed.	Complied and Closed.









BID COMMENTS / CLARIFICA	ATIONS
Project: RFP Collective No. PR7000006947	Bidder: GE
GTG 1-8 Rehabilitations Clarification # (GE PBC-I&C-004)	Bidder's Ref: Proposal dated June 14 2015

S. No.	Reference in Bid Document	MARAFIQ TSD comment on 2 nd August , 2015	Bidder's Response on 12 th August 2015	Marafiq Comments on 18 th August 2015	GE Comments 8/26	Status MARAFIQ RESPONSE dtd. 29.08.2015
1.	A P.O. Box I NET INC. P. Organizaria	As per MARAFIQ SOW (Section –IV C, III. Technical Requirement, 2. Engineering and design responsibilities, item f) Contractor shall submit power load requirement analysis for the equipment to be upgraded Please submit the details	Noted. Will be provided	Complied and Closed.	Noted and Closed	Complied and Closed.
2.	111 (86) 1-111 / www. 12-111 (86) 1-111 / www. 12-111 / www. 12-1111 / www. 12-111 / www. 12-1111 / www. 12-111 / www. 12-1111 / w	As per MARAFIQ SOW (Section –IV C, III. Technical Requirement, 3. MARK VIe system capabilities, Operator Interface) A trip history shall include up to 200 alarms, 200 events, 200 SOE messages, and analog data before and after the trip. Please confirm	Confirm.	Complied and Closed.	Noted and Closed	Complied and Closed.
3.	Section 4.4, Page 42, Instrumentation, RVDT for IGV	As per MARAFIQ SOW (Section –IV R, I. Technical Requirement, 4.Detailed Scope of Work Description, Item 1.2 Replacement of RVDT with LVDT) The Bidder shall replace existing RVDT with LVDT for position sensing feedback of IGV for frame 7E GTG1-8. Please clarify & confirm.	Confirm GE will Replace RVDT with LVDT.	This response is contradicting with GE's own response given in GE-PBC-l&C -001 dt.1 Aug.2015. Bidder has stated to provide the justification why RVDT shall not be replaced in earlier response.	Please refer to GE-PBC-I&C - 001 item 6.	Complied and Closed. ARAFIO
4	Section 4.4, Page 42, Documentation	As per MARAFIQ SOW (Section –IV R, I. Technical Requirement, 5. Scope of Supply, Item 37 cause and effect matrix)	Confirm	Complied and Closed.	Noted and Closed	Complied and Closed.





BID COMMENTS / CLARIFICA	ATIONS
Project: RFP Collective No. PR7000006947	Bidder: GE
GTG 1-8 Rehabilitations Clarification # (GE PBC-I&C-004)	Bidder's Ref: Proposal dated June 14 2015

		The bidder shall develop detailed cause and effect matrix based on the trip logic for GTG 1-8. Contributive trip signals shall be provided in GTG 1 to 9 SOE in Mark Vie and SOE report shall be comprehensive in providing the actual cause of the trip. Please confirm				
5	Section 4.4, C Bill of Material, Page 49, Hardware Description, Mark Vie Dual Controller with Simplex IO turbine controller	As per MARAFIQ SOW (Section –IV R, III. Technical Requirement, 5. Scope of Supply, Item 1) The bidder shall replace the existing GTG 1 to 8 MARK V Simplex, and GTG 9 MARK V TMR, with GE recommended state-of-art MARK VIe or latest revision available simplex for GTG 1 to 8 eight(8) numbers and Triple Module Redundant (TMR) for GTG 9 one(1) number. Please clarify dual controller with Simplex IO functionality in detail.	Dual controller is redundancy in controllers with Simplex IO.	Complied and Closed.	Noted and Closed	Complied and Closed.
6	Section 4.4, Proposal basis, Page 54, Item 19,20,21 & 23	These exception are not acceptable, As per MARAFIQ SOW (Section –IV R, III. Technical Requirement, 5. Scope of Supply, Item 24) Contractor's scope of work includes all Ethernet and Fiber optic cable and termination devices provision, verification, modification, replacement as required for the contract scope of work for replacement of MARK V with MARK VIe or latest revision and also Ethernet and Fiber Optic requirement if any to interface with UCS & Control Room HMI.	Confirm	Complied and Closed. P.O. Box 1921 Complied and Closed.	Noted and Closed	Complied and Closed. Closed.





BID COMMENTS / CLARIFICATIONS				
Project: RFP Collective No. PR7000006947	Bidder: GE			
GTG 1-8 Rehabilitations Clarification # (GE PBC-I&C-004)	Bidder's Ref: Proposal dated June			

		Please Clarify.				
7	Section 4.4, C Bill of Material, Page 51, Control Room Desktop EWS HMI Server Hardware/Software	GE shall provide MS office software for EWS, Please confirm.	Confirm	Complied and Closed.	Noted and Closed	Complied and Closed.
8	Section 4.4, Proposal basis, Page 54, Item 8	If DLN for NOx control supplied by GE then DLN tuning shall be done by GE. Please confirm	Confirm	Complied and Closed.	Noted and Closed	Complied and Closed.
9		Please confirm NOx emission < 80ppm after Water injection or DLN 1 implementation.	Confirm for Gas Operation only. If liquid fuel is used, then either Water Injection or combination of both shall be considered. Marafiq to note the effect of the water injection on Maintenance factor as this will surely increase the maintenance re- occurrence	Noted and Closed. P.O. Box / 1921 P.O. Box /	(Euler) The second of the se	Complied and Closed. Signal of the Contracts Dept.
10	1- Marafiq YANBU - Plant Rehab- 778781-15- YGTZ Technical (2)	All the Functional Test for all the systems shall be demonstrated during inspection & testing. Please confirm	Confirm	Complied and Closed.	Noted and Closed	Complied and Closed.
11	1- Marafiq YANBU - Plant Rehab- 778781-15- YGTZ_Technical (2)	Turbine Protection Test shall be included in the proposal.	This is part of SAT procedure which will be submitted before execution	Noted and Closed.	Noted and Closed	Complied and Closed.
11	1- Marafiq YANBU - Plant Rehab-	Redundancy Concept shall be furnished in details (Ex. Turbine Solenoid power supply)	GT1-8 are simplex controls. Only GT9 is	Please update and elaborate the Turbine tripping in Mark Vie.	Tripping philosophy is similar to Mark V	Complied and Closed.

3.2 96



BID COMMENTS / CLARIFICA	TIONS
Project: RFP Collective No. PR7000006947	Bidder: GE
GTG 1-8 Rehabilitations Clarification # (GE PBC-I&C-004)	Bidder's Ref: Proposal dated June 14 2015

	778781-15- YGTZ_Technical (2)		TMR system. Please elaborate requirement,		Turbine over speed protection is available in three levels; control, primary, and Emergency. Control protection comes through closed loop speed control using the Fuel/steam valves. Primary over speed protection is provided by the controller. Emergency over speed protection is provided by the independent Protection core.	
13	1- Marafiq YANBU - Plant Rehab- 778781-15- YGTZ Technical (2)	Redundancy topology and Redundancy Testing shall be furnished in detail.	This is part of SAT procedure which will be submitted before execution.	Noted and Closed.	Noted and Closed	Complied and Closed.
13	1- Marafiq YANBU - Plant Rehab- 778781-15- YGTZ_Technical (2)	Hot Commissioning Test (Tests after synch in load operation shall be clarified in detail)	This is part of SAT procedure which will be submitted before execution	Noted and Closed.	Noted and Closed	Complied and Closed.









BID COMMENTS / CLARIFICATIONS Project: RFP Collective No. PR7000006947 Bidder: GE Bidder's Ref: Proposal dated June 14 2015

R. 1010223377 1-1-141

14	4.17 Installation of Ventilation Fan &	Please provide the details about the Scope of Supply , Installation , Integration and Commissioning of this units	Pls refer to clarification number GE-PBC-I&C- 002_R1_GE point # 26 for the reply	Not complied and pending. Bidder to submit proposal for all items included in base proposal. Bidder can propose Air Cooled Generator and other stuff as an alternative offer or optional item. MARAFIQ will study and accordingly bidder shall be notified for the final decision. Bidder to provide response.	Please refer to GE-PBC-I&C- 002_R1_GE point # 26 has been updated.	Complied Closed.	and
	Hydrogen Detector inside DCC	Please provide the details about the Technical specification for the HVAC System and Hydrogen Sensor for DDC	Pls refer to clarification number GE-PBC-I&C- 002_R1_GE point # 26 for the reply	Not complied and pending. Bidder to submit proposal for all items included in base proposal. Bidder can propose Air Cooled Generator and other stuff as an alternative offer or optional item. MARAFIQ will study and accordingly bidder shall be notified for the final decision. Bidder to provide response	Please refer to GE-PBC-I&C- 002_R1_GE point # 26 has been updated.	Complied Closed.	and





BID COMMENTS / C	CLARIFICATIONS
Project: RFP Collective No. PR7000006947	Bidder: GE
GTG 1-8 Rehabilitations Clarification # (GE PBC-I&C-005)	Bidder's Ref: Proposal dated June 14 2015

S. No.	Reference in Bid Document	MARAFIQ comment on 30th August , 2015	GE Response 13th Sept 2015	Marafiq Remarks
		1. The statement to replace the existing operator interfaces with modern HMIs does not explicitly imply that the latest HMI version would be installed. Please have the Contractor indicate in the detailed design that the hardware and software to be provided in this project will be the latest version of the product. (Note: GE Cimplicity HMI software, including Windows 7 Ultimate 64 Operating System does not mean the latest version.)	Please note that latest HMI version means the approved and tested version of GE will be provided at the time of Detailed design stage. It may be noted that even though OS available in open market is Windows-10, At the time of design phase If only available OS which is tested and approved by GE is windows-7, only windows-7 will be supplied.	Complied and Closed.
		2. SOPHOS antivirus was mentioned. MARAFIQ uses McAfee Antivirus universally. Can this be supplied?	McAfee can be provided. Version of McAfee which is validated by GE will be supplied.	2. Complied and Closed.
1	Operator Interface HMIs	3. Please define the Network Architecture applicable to this proposal—CCB /TCC. The VMS was included in the control layout but not in the Bill of Materials or anywhere.	Preliminary Network topology will be provided. VMS will be added.	3. Complied and Closed.
		4. EWS computer in CCB is an addition. Does it mean that logic changes/forcing can only be done at CCB and not at the local HMI?	4. Logic Changes can be done at all HMIs.	4. Complied and Closed.
1010223377	A Gen Lagar	5. Any changes in the existing HMI displays should be updated in the ABB DCS.	5.Confimred بالرة الشتيات والمتواد المجاورة الشتيات والمتواد المجاورة المج	5. Complied and Closed.
71.1.17	ويشرونونال الله كا	6. Excitation system changes shall also be reflected in the DCS.	6.Confirmed	6. Complied and Closed.
MO	Company of the second of the s	7. Bentley Nevada VMS, if utilized, shall be integrated to DCS.	7. Confirmed Bentley Nevada VMS shall be integrated to DCS	7. Complied and Closed.



BID COMMENTS / 0	CLARIFICATIONS
Project: RFP Collective No. PR7000006947	Bidder: GE
GTG 1-8 Rehabilitations Clarification # (GE PBC-I&C-005)	Bidder's Ref: Proposal dated June 14 2015

S. No.	Reference in Bid Document	MARAFIQ comment on 30th August , 2015	GE Response 13th Sept 2015	Marafiq Remarks
2.	Interface of Mark 6e with	1. The Mark Vie allows modern Ethernet networks to be utilized. The current HMI interface of RS232 Modbus Protocol to DCS through ABB IMMFP12 modules could also be replaced by upgrading to Ethernet- capable ABB BRC-4xx modules as DCS interfaces supported by the newly installed Engineering Workstation (EWS) Composer on-site. It would make the GTG 1-9 communication setup ready for the Symphony plus Upgrade Project that is forthcoming. This would avoid future problems that will be encountered later.	Noted. This will be verified with DCS vendor and will be included.	1.Complied and Closed.
	DCS	2. Changes in the I/O mapping in HMI/Mark Vie should also be changed in the DCS side. There is a possibility that if the current I/O mapping would be modified, the current DCS mapping in IMFFP12 could not work due to the new version of Composer (EWS) installed on-site. In that case, upgrade to BRC-4xx would become mandatory.	Noted. This will be verified with DCS vendor and will be included.	2.Complied and Closed.
		SOE shall be through the GSM protocol as with the existing setup.	3. Confirmed.	3. Complied and Closed.







IV F - SCHEDULE OF TECHNICAL DEVIATIONS
GTG Rehabilitation by Replacement of Major Parts, Yanbu

Information to be provided by the Bidder in response to IV-F clause 7.1 shall be provided using the following form. Bidder to state how its proposal deviates from the ITB requirements and give justification for each non-compliance.

GE submitted Technical Clarifications and Technical Proposal shall prevail

Name of Bidder

General Electric International Inc.

la.	ITB Doc/Clause Ref	As Specified	Proposed Deviation	Justification	Jeave blank for MARAFIQ use	Status	GE Comment 03 NOV 2015	Comment By GE	Marafiq Comment 04 NOV 2015	GE Comment 11 Nov 2015	Marafiq Comments 11th Nov 2015	GE Comment 11 Nov 2015 rev 01
1	1.5 Scope of Services.	The Contractor's scope of services shall include the following as a minimum. The scope of services for each task includes complete field survey and verification of existing utility system interfaces, engineering and design services, manufacturing, procurement, coordination/interface with other contractors, construction and testing as well as the provision of associated drainage, erosion control, detours and all pertinent items as described below, and as necessary to complete the work satisfactorily. The bidder shall take dismantled Part from Rehabilitation and Available Capital Spares from Marafiq Ware house in the Parts Exchange Programme (Whichever applicable). The Contractor shall provide onsite personnel as required throughout the design period to obtain the necessary information. Contractor shall provide on-site personnel, as required, to retrieve information from as-built drawings and other documents at the MARAFIQ Library, required for preparation of designs, drawings and specifications for the work under this Contract. On-site personnel shall include a minimum		Bidder has their own design practices that is being followed for drawing formats and codes.	Acceptable subject to the condition bidder shall follow their own design practices being followed for GE designed and manuafctured equipment. Other than this bidder shall follow the MARAFIQ guide specifications, RC standrads and appliacable international standards.	Closed						
		of one engineer with experience of GTG plants from initiation of design through the intermediate design submittal and review. In addition, the Contractor shall assign an on-site coordinator during the entire design phase.										
		The preparation and submission of design, construction and shop drawings, specifications, system analysis, studies, calculations, DCS documents, product data and samples pertaining to all engineering disciplines, for review and approval by MARAFIQ. Process system studies and analyses must be performed and presented to MARAFIC before design drawings are finalized or equipment is purchased. Refer to detailed sow for additional study/analysis requirements for each item. All design drawings, except existing drawings requiring revisions, shall be prepared by the Contractor using Bentley Micro-station drafting methods. Refer to Technical Requirements and Section 01720 Record Documents.										
		The preparation and submission of cutover plans and work- around plans for activities that require interface with energized and operational systems and equipment.										
		The provision of all purchasing, expediting, inspecting, delivering, handling and interim storage of materials and equipment required for the work.						,				
		The provision of all materials, equipment, supervision and labor necessary to complete the work in accordance with the approved design and specifications.										
2	2.1 Site Survey	The contractor shall examine the site for investigation and satisfy himself, with the nature of work and setting of site where the contract shall be performed. It is deemed that the contractor has understood the nature of work prior to submitting of proposal, any discrepancies arising regarding the amount and nature of work, correction to it shall be done by the contractor at no additional cost to the owner.	rectification of any pre existing conditions, where the Work Scope has not been included in Bidders		additional work is not included in RFP, and not raised and investigated by bidder during prebid and post bid technical clarifications.	Closed						
3	2.2.A	It is deemed necessary that contractor has obtained all the required information and data, which are required for effective and timely completion of work in highly professional and qualitative manner.	Bidder Shall have all applicable Drawings and Technical information prior to bid, contract establishment	Bidder Shall have all applicable Drawings and Technical information prior to bid, contract establishment	Noted , However Marafiq provided all the required information during pre bid and post bid clamfication further additional details is required GE can approach MARAFIQ Diocurrentation Centre, Library for the getting the same.	Closed						
4	2.2.C.: .	The work shall comply with applicable Marafiq Specifications and Standards, RC Design Criteria / Guideline Specifications, Industry Codes/standards and shall be based on good engineering practices.	Bidder will provide parts to GE specs or international standards as applicable,	Bidder will provide parts to GE specs or international standards as applicable.	Acceptable.Closed.	Closed						
5	2 2.D	Engineering work shall include but not be limited to Detailed Design of the Work.	Engineering design documents shall be submitted as appropriate	Engineering design documents shall be submitted as appropriate	Acceptable.Closed.	Closed		1000	n uc			
8	22F	Construction shall consist of mobilization, site preparation, installation of equipment, electrical and instrumentation works, electrical grounding, all other works required for complete and satisfactory operation. Furthermore, the works shall be tested and commissioned prior to Contractor's demobilization.	bid and post-bid clarifications	Work scope should be applicable as per the Agreed Scope of work in Bidder's proposal and through pre-bid and post-bid clarifications	Acceptale , the same as per SOW.	Closed		P.O. Box / 18211 Riyadh / 11477	1-711/m			MARAF MARAF



7	22G	In accordance with Marafiq procedures, the Contractor has to obtain Marafiq's concurrence for the pre-qualification of major material suppliers/vendors & sub-contractors for design and construction.	Bidder will share all available data for all approved GE Suppliers that will be supplying any major equipment to Marafig, approvals should not be witheld unreasonably	Bidder will share all available data for all approved GE Suppliers that will be supplying any major equipment to Marafig, approvats should not be witheld unreasonably	Acceptable subject to the condition MARAFIQ shall review and approve the sub-contractors' list and vendors' list with prior submission and appropriate time for review and approval.	Closed	GE will provide. Please Provide Marafiq's pre- approved Vendor List.				
8	22H	All components and accessories shall be supplied by the Contractor and shall be based on Industry standard applied to tropical country and to area in proximity to seashore ambient conditions of 55°C maximum temperature and \$-100% relative humidity.	Bidder takes exception to "Industry Standard" and replace with "Prudent Industry Practices" wherein "Prudent Industry Practices" means the exercise of that degree of skill and diligence, and of such practices, methods and acts, at a minimum, as would ordinantly be expected in the power generation industry from a prudent owner and/or operator or service provider (as applicable) acting lawfully, reliably and safely in connection with power generation facilities and equipment similar to the Facility and Covered Unit(s)	Bidder takes exception to "Industry Standard" and replace with "Prudent Industry Practices" wherein "Prudent Industry Practices" wherein in "Prudent Industry Practices" means the exercise of that degree of skill and difigence, and of such practices, methods and acts, at a minimum, as would ordinarily be expected in the power generation industry from a prudent owner and/or operator or service provider (as applicable) acting tawfully, reliably and safely in connection with power generation facilities and equipment similar to the Facility and Covered Unit(s)		Closed					
9	22.1	This scope of work describes all the work and work related activities to be carried out by the Contractor. Any specific work or activity inadvertently not included in the scope of work but deemed to be necessary for the successful operation of the installation as intended by this document shall be considered as included in the scope of work of the Contractor.	Marafiq shall issue a Change Order for any Work that is result of an evaluation of the existing equipment, or rectification of any pre-existing conditions, where the Work Scope has not been included in Bidders Techincal Proposal, pre/post bid clarifications, or any additional/extra work requested by Marafiq.	Marafiq shall issue a Change Order for any Work that is result of an evaluation of the existing equipment or rectification of any pre existing conditions, where the Work Scope has not been included in Bidders Techincal Proposal, pre/post bid clanfications, or any additional/extra work requested by Marafiq.	Not Acceptable, as a EPC contract the sucessful completion of the project necessary work to be considered by bidder. Bidder shall evaluate the additional amount of work associated with existing equipment which are not included in RFP, pre bid and post bid clarifications. Bidder shall raise additional work identified and evaulauted which is deemed necessary for successful completion by him before award of the contract	Closed	General Terms and Conditions of the contract will apply particularly GC 38 Changes and Extra Works				
10	224	All design and shop drawings, calculations and such other documents once approved by Marafiq shall not be revised or modified without written prior approval from MARAFIQ.	GE designs are based on GE design practices and methods/codes that have been used and proven, exception taken to submit specific shop drawings, ordering drawings, or any other proprietary information.	GE designs are based on GE design practices and methods/codes that have been used and proven, exception taken to submit specific shop drawings, ordering drawings, or any other proprietary information.	Acceptable:Exception applicable only GE Propritery information only. Other than GE proprietary, the contractor shall submit design and shop drawings, documenst for review and approval.	Closed	see commant	Documents linclude General arrengement DWGs, Site Layout, Schematic/P8ID markups, typically required for O&M and installation			
11	2.2 L	All equipment and shall be designed for not less than 30-years of service life under normal operating conditions with specified maintenance.	Bidder takes exception, Not all devices and components can meet the 30 year ife. There will be some maintenance items that do not meet 30 year life, and if equipment is not maintained properly will not last 30 years.	Bidder takes exception, Not all devices and components can meet the 30 year life. There will be some maintenance items that do not meet 30 year life, and if equipment is not maintained properly will not last 30 years.		Closed					
12	220	MARAFIQ safety procedures shall be followed during the construction and commissioning period of the project.	MARAFIC AND GE SAFETY ENGINEER TO DISCUSS THE ONE GE plan + MARAFIC SAFETY PLAN AND AGREE ON ONE SAFETY PLAN FOR THE PROJECT.	MARAFIQ AND GE SAFETY ENGINEER TO DISCUSS THE ONE GE plan + MARAFIQ SAFETY PLAN AND AGREE ON ONE SAFETY PLAN FOR THE PROJECT.	Acceptable Closed.	Closed					
13	22P	The Contractor shall submit the design drawings/documents and materials/equipment purchase requisitions formally to Marafiq for review and approval. The procurement shall be carried out only after approval from Marafiq.	GE DRAWINGS/DOCS, STANDARDS,SPECS SHALL NOT BE FOR APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION.	GE DRAWINGS/DOCS, STANDARDS,SPECS SHALL NOT BE FOR APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION.	Not Acceptable, The bidder shall understand that design documents and drawings for GE propertory items not required for approval. Applicable for other GE equipment(design drawings/documents and standards) and Rest of the non properitory GE items, equipment are applicable and contractor shall provide all design documents and drawings for review and approval.	Closed	see comment	Documents linclude General arrengement DWGs, Site Layout, Schematic/P&ID markups, typically required for O&M and installation			
14	220	Contractor shall arrange for power, water, and worker facilities, etc. for their site office, and for Construction and testing purposes.	MARAFIQ TO CONFIRM WHAT FACILITIES ARE AVAILABLE ON SITE.	MARAFIO TO CONFIRM WHAT FACILITIES ARE AVAILABLE ON SITE.	Bidder shall arrange all facilites and utilities required by their own cost required for their staff and project executuion. If anything provided by Marafiq will be additional cost to be paid by EPC contractor to Marafiq prevailing rate for the same.	Closed	Maraliq to provide, prices and site layout DWG for GE Site Office Area		We would like communicate that the following Privailing rate for the utilities Electricity: 1 MVA -15 Halla (Summer) & 12 Halla (Winter) KWH Greater than 1 MVA -15 Halla (Summer) & 14 Halla (Winter)/KWH and SAR 250/KVA for Connection Fees. WATER: SAR 7 34 /Cu.M & Sanitary SAR 2.89 / Cu.M and SAR 300 / Connection. RC Land Rental Charges SAR 8/ Sq.MUYear		
15	22.0	Contractor shall perform and complete the work in accordance with the contract and to the satisfaction of MARAFIQ and shall comply and adhere to his/their instructions and directions		The scope of work performed shall be in accordance with The Contract, pre/post-bid clarifications and GE Porposal and per OEM recommedation Acceptance by Marafiq should be based on the work scope defined The Contract, pre/post-bid clarifications and GE Porposal	Acceptable Closed.	Closed					Supply Supply

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16	22 V	Contractor shall submit equipment catalog and shop drawings, project drawings, connection diagrams and other submittals in accordance with the requirements of the applicable standards and subject to MARAFIQ approval prior to the procurement of any equipment and materials.	GE DRAWINGS/DOCS, STANDARDS SPECS SHALL NOT BE FOR APPROVAL, SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION.	GE DRAWINGS/DOCS, STANDARDS,SPECS SHALL NOT BE FOR APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION.	Not Acceptable. The bidder shall understand that design documents and drawings for GE properitory items not required for approval. Applicable for other GE equipment(design drawings/documents and standards) and Rest of the non propentory GE items, equipment are applicable and contractor shall provide all design documents and drawings for review and approval.	Closed	see comment	Documents linclude General arrengement DWGs, Site Layout, Schematic/P&ID markups, typically required for O&M and installation			
17	2 2 X	Contractor shall provide a written guarantee covering the materials and workmanship against the latent defects and other physical damages due to the normal wear and tear for a period of one year from the date of acceptance of the work by MARAFIO.	GE WILL PROVIDE WARRANTY ON PARTS AND SERVICES PER CONTRACT AGREEMENT.	GE WILL PROVIDE WARRANTY ON PARTS AND SERVICES PER CONTRACT AGREEMENT.	Acceptable Closed	Closed					
18.	22Y	Contractor shall be responsible that all project drawings, construction materials, equipments, installation and workmanship provided under this contract comply with the contract provisions. Revision or submittals approval by MARAFIQ does not release the contractor from his obligation regarding equipment performance in accordance with applicable codes and standards and specifications.	GE DRAWINGS/DOCS, STANDARDS SPECS SHALL NOT BE FOR APPROVAL, SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION.	GE DRAWINGS/DOCS, STANDARDS,SPECS SHALL NOT BE FOR APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION.	Not Acceptable. The bidder shall understand that design documents and drawings for GE properitory items not required for approval. Applicable for other GE equipment(design drawings/documents and standards) and Rest of the non propentory GE items, equipment are applicable and contractor shall provide all design documents and drawings for review and approval.	Closed	see comment	Documents linclude General arrengement DWGs, Site Layout, Schematic/P&ID markups, typically required for O&M and installation			
19	25A	The contractor and its subcontractors performing work at the site shall be required to comply with and enforce strictly all the required MARAFIQ Industrial Safety rules, regulations and practices.	MARAFIQ AND GE SAFETY ENGINEER TO DISCUSS THE ONE GE plan + MARAFIQ SAFETY PLAN AND AGREE ON ONE SAFETY PLAN FOR THE PROJECT	MARAFIQ AND GE SAFETY ENGINEER TO DISCUSS THE ONE GE plan + MARAFIQ SAFETY PLAN AND AGREE ON ONE SAFETY PLAN FOR THE PROJECT.	Acceptable Closed.	Closed					
20	2.5.B	The contractor shall coordinate with MARAFIQ Industrial Safety section. The contractor shall have deemed to understand all the safety requirements related with the work and is responsible to act upon accordingly.	MARAFIO AND GE SAFETY ENGINEER TO DISCUSS THE ONE GE plan + MARAFIO	MARAFIQ AND GE SAFETY ENGINEER TO DISCUSS THE ONE GE plan * MARAFIQ SAFETY PLAN AND AGREE ON ONE SAFETY PLAN FOR THE PROJECT.	Acceptable, Closed.	Closed					
21	27Submittats point of delivery	Contractor shall deliver miscellaneous submittals for review and approval by MARAFIQ designated representative.		GE DRAWINGS/DOCS, STANDARDS,SPECS SHALL NOT BE FOR APPROVAL. SUCH REQUIREMENT MAY DISTURB PROJECT EXECUTION.	Not Acceptable. The bidder shall understand that design documents and drawings for GE propertory items not required for approval. Applicable for other GE equipment(design drawings/documents and standards) and Rest of the non propentory GE items, equipment are applicable and contractor shall provide all design documents and drawings for review and approval.	Closed	see comment	Documents linclude General arrengement DWGs, Site Layout, Schematic/P&ID markups, typicatly required for O&M and installation		=	
22	28.8.	The contractor shall observe and exercise professionalism, care and diligence in performing the work in a manner acceptable to the industry.	Bidder takes exception to "Industry Standard" and replace with "Prudent Industry Practices" wherein "Prudent Industry Practices" wherein "Prudent Industry Practices" means the exercise of that degree of skill and diligence, and of such practices, methods and acts, at a minimum, as would ordinarily be expected in the power generation industry from a prudent owner and/or operator or service provider (as applicable) acting lawfully, reflably and safely in connection with power generation facilities and equipment similar to the Facility and Covered Unit(s)	Bidder takes exception to "Industry Standard" and replace with "Prudent Industry Practices" wherein "Prudent Industry Practices" means the exercise of that degree of skill and diligence, and of such practices, methods and acts, at a minimum, as would ordinanily be expected in the power generation industry from a prudent owner and/or operator or service provider (as applicable) acting lawfully, reliably and safely in connection with power generation facilities and equipment similar to the Facility and Covered Unit(s)		Clased					
23	2.8.CSecurity	Contractor should perform the job within Three year total for Gas Turbine 1 to 8.	Bidder Takes Exception, final Schedule is based on exact option and shutdown schedules.	Bidder Takes Exception, final Schedule is based on exact option and shutdown schedules.	Acceptable subject to the condition that bidder shall plan the rehabiliation of each GTG unit under planned outage. Outage plan for each GTG shall be mutually agreed between MARAFIG and GE to cope up with the project	Closed					
24	2.12 b)	No change shall be made by the contractor without an order in writing of MARAFIQ.	Only such change effects major scope of work and such approvals shall not be unreasonably witheld by Marafig. If there is no substantial change then GE should be allowed to proceed without approval.	Only such change effects major scope of work and such approvals shall not be unreasonably witheld by Marafig. If there is no substantial change then GE should be allowed to proceed wittout approval.	achedule. Acceptable subject to the condition all such changes shall be brought to MARAFIQ notice prior implementation and shall be agreed mutually for smooth execution without causing delay and cost impact to project schedule.	Clased	closed, GE to accept Marafig Comment				
25	2.12.0)	All extra or additional work done, work omitted by order of MARAFIO shall be valued at the rates and prices set out in the contract.	With the exception of substantial change Bidder will invoice per agreed price	With the exception of substantial change Bidder will invoice per agreed price	Any addition / deletion in the Scope of Works shall be covered by an approved change order which is mutually agreed upon by both parties. GC 38 of the General Terms and Conditions will apply for such changes.	Closed	closed, GE to accept Marafiq Comment				
28	2.13. Protection of Existing Facilities	The contractor shall be responsible for protection of the existing installations and preventing any loss caused by personnel or equipment movement while working at site. The contractor shall take every positive action to protect the existing facilities from any damage resulting during implementation of this project. Unless otherwise specifically directed the contractor shall protect all existing facilities from any loss and prevent interruption of the services. The contractor shall be fully responsible for any damage to the existing installations during the execution of work. Any loss, if occurred, shall be repaired and/or replaced, to restore to the original condition, at no additional cost to the owner.	FOURMENT THAT IS NOT LINDER GE	GE CANNOT BE RESPONSIBLE FOR EQUIPMENT THAT IS NOT UNDER GE CONTROL.	Bidder shall understand existing facilities, equipment which are damaged OR affected due to implementation of this project is responsibility of the bidder for the restoration to its original condition.	T&C	Should be part of the T&Cs discussion		GC 9, Liability, Indemnity and Release provision of the of the Contract General Terms and Conditions will apply.		
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27	2.14.A	It is deemed necessary that contractor has obtained all the required information and data, which are required for effective and timely completion of work in highly professional and qualitative manner.	Bidder obtained visual information of the equipement at site. No Tests were performed to evaluate the operational reactiness of the equipement. Issues with equipment that are identified during execution of project and noted as pre-existing will be handled as change orders. Each machine will go through a Pre-Outage test to obtain/baseline data and ensure component operability prior to being turned over to GE for Rehabilitation. If any pre-existing condition not covered under the Scope of Work per contract, Bidder's Technical Proposal, Pre/Post Bid Clarifications, rectification of such condition shall be extra/additional work.	Bidder obtained visual information of the equipement at site. No Tests were performed to evaluate the operational readiness of the equipement. Issues with equipment that are identified during execution of project and noted as pre-existing will be handled as change orders. Each machine will go through a Pre-Outage test to obtain/baseline data and ensure component operability prior to being turned over to GE for Rehabilitation. If any pre existing condition not covered under the Scope of Work per contract, Bidder's Technical Proposal, Pre/Post Bid Clarifications, rectification of such condition shall be extra/additional work.	the unit condition prior rehabilitation.	Closed	Pre shut down Performance Test Shall- be carried out , clause limited to Performance Test.		
28	3.3 Protection of existing facilities	The contractor shall be fully responsible for the damage of any existing facilities during the execution of work any damages, if occurred, shall be built by repairing and/or replacing, to restore to the original conditions, at no additional cost to the MARAFIQ.	RESPONSIBLE FOR EQUIPMENT NOT UNIT ITS CONTROL.	MARAFIQ TO CLARIFY: GE CANNOT BE HELD RESPONSIBLE FOR EQUIPMENT NOT UNIT ITS CONTROL.	Bidder shall understand existing facilities are affected due to implementation of this project, bidder is solely responsible for the restoration of the same facility to original condition.	T&C	Should be part of the T&Cs discussion	GC 9, Liability, Indemnity and Release provision of the of the Contract General Terms and Conditions will apply.	
29	3.4.b)	Demobilization includes all work related to moving out, upon satisfactory completion of work and shall include removal of equipment, tools, supplies and personnel and disposing of excess materials. It also includes the final submittals of As-Built drawings.	To the extent that the equipment, tools, supplies are GE's.	To the extent that the equipment, tools, supplies are GE's.	Acceptable subject to the condition contractor shall remove all site offices, utility connections, equipment and tools utilized for excecution of the project from the site and restore the site to original condition.	Closed	closed, GE to accept Marafiq Comment		
30	3.5. Assignment of contract, subcontract and purchase order	The contractor shall be authorized to subcontract a portion of the work to others but shall not subcontract the whole of the work. The contractor shall not subcontract any part of the work without prior written consent of MARAFIQ, and such consent, if given, shall not relieve the contractor from any liability and obligation under the contract.	To the extent that such consent shall not be reasonably witheld,	To the extent that such consent shall not be reasonably witheld.	Not Acceptable. The bidder must identify the work which are planned for sub-contracting before award of the contract. Liability of sub-contracting work shall lie with the main contractor.	Closed			
31	3.7.7.7 NARRATIVE REPORT	The narrative report, in the form prescribed by MARAFIQ, shall consist of a general summary and descriptive data of contract progress, including description of any anticipated or actual variations from the Contract Schedule, an assessment of the impact of such variations, and a statement of proposed corrective action. The general outline for the narrative report will be the following: Section 1 – General Overall Project Summary Cash Flow Forecast Overall Cost reporting inclusive of change order status Areas of concem/claims Progress curves Man-hour forecasts Change Order log Engineering - percent completed (as applicable) Procurement – progress matrix as Annex B Construction – percent completed Weather Summary Melestones completed. Summary Contract Schedule Section 2 – Engineering activities such as drawings, system analysis, calculations, shop drawings, and asbuilt drawings. Description of problem areas Planned accomplishments for the next sixty (60) days including scheduled deliverables Engineering drawing status report by major discipline	Contractor's format	Bidder to submit Reports in standard Bidder's / Sub Contractor's format	O.K.Noted, However the bidder shall comply the Marafiq requirments	Closed	A Monthly Report is submitted, Billing Status will be included instead of Cashflows and Overall Cost reporting is not provided by GE as part of such reports.		
32	3.7 7 10 TIE-IN WITH EXISTING FACILITIES	Design (rends status Contractor is responsible to get all necessary work permits from the relevant authorities to carry out the work on the existing systems for tie-in connections to the relevant systems. Where the work requires shutdown of the necessary services, the Contractor shall schedule the tie-in works two months in advance in coordination with MARAFIQ Operations, through the MARAFIQ designated project engineer. All such tie-in / shut down schedules will subject to MARAFIQ agreement and approval. Contractor may request in advance the concerned plant shutdown schedule through designated project engineer from Marafiq Operation. Contractor shall submit with the method of statement the work shall be done, a detail schedule and timing for each work requiring shutdown including necessary sketches.	should not be held liable if the delay is attributable to Marafiq.	All schedule should be mutually agreed and Bidder should not be held liable if the delay is attributable to Marafiq:	Acceptable.Closed.	Closed			رانداه



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33	commissioning	The contractor shall be responsible for performing a complete installation, testing and commissioning after the rehabilitation/replacement completed, as specified, conforming to the MARAFIQ approved Scope of Work, professional standards of skill; performing work of a similar nature. Unless otherwise expressly provided herein, all materials and equipment shall be new and shall conform to the specifications, drawings, samples and other descriptions set forth in this contract or provided by contractor and approved by MARAFIQ.	GE will commission and test new equipment per GE standards and documents to ensusre completed work is per GE standards to meet the contract requiredments with Marafiq	GE will commission and test new equipment per GE standards and documents to ensurre completed work is per GE standards to meet the contract requiredments with Marafiq	Acceptable	Closed					
9	3.8.8.1 a	Marafiq reserves the right to witness all tests. Contractor shall give two months (60 days) advance notice to the scheduled test.	Marafig to notify the contractor formally to witness a particular test not previously agreed too.	Marafiq to notify the contractor formally to witness a particular test not previously agreed too.	Acceptable Closed.	Dased		Bidder si compliès the demand a Marafiq i reserves the witness all	Project as ight to	No response from Ws GE	This was already discussed on the meeting and closed. GE Requests Marafiq to define the tests they wan to witness at the coordination meeting at project
5	3.8.8.4 TRAINING TO MARAFIQ STAFF	Contractor shall provide training on site for MARAFIQ O&M personnel. Training shall be conducted by qualified & competent personnel who are thoroughly knowledgeable with the theory, operation and maintenance of the new equipment.	Marafiq To Select Trainings per submitted GE List	Marafig To Select Trainings per submitted GE List	Acceptable.Closed.	Closed					
36	3.10.8.5Site acceptance test (SAT)	MARAFIQ shall have the right to witness at any time any test performed hereunder by Contractor or its vendors or Subcontractors, and Contractor shall give MARAFIQ reasonable advance notice of any such test in accordance with MARAFIQ requirements. The SAT, Site Acceptance shall be in accordance with accepted International Standards. SAT procedures shall be complete unto themselves. A full set of function simulation test for the all GTG1-8 with response checking shall be included.	All testing shall be agreed upfront as random testing is may slow the project down and impact overall schedule. Marafiq to notify the contractor formally to witness a particular test not previously agreed too.	All testing shall be agreed upfront as random testing is may slow the project down and impact overall schedule. Marafiq to notify the contractor formally to witness a particular test not previously agreed too.	Not accepable. Bidder must comply with the requirements to meet the quality of work.	Closed					
37	3 11,11 2 . Equipment Maintenance Strategies	Equipment maintenance strategies in projects for Marafiq Yanbu should be based on the principles of Reliability Centered Maintenance (RCM). Justification of maintenance tasks shall be based on the specified equipment failure modes, the characteristics of these failure modes in terms of MTBF, the consequences of failure based on production loss and the cost of execution of maintenance including the resource and downtime costs.	GE has maintenance schedules developed for its equipment installed	GE has maintenance schedules developed for its equipment installed.	Acceptable subject to the condition GE shall develop maintenance schedules based on the RCM requirements.	ppen	Pass all OEM recommendation for O&M	know in which OEM will dev Prevent Mantena strategy, as purpose of ea in the PM should this prevent) as justification PM frequenc Cleaning of	provide technical direction during the project execution to answer questions relating to maintinance or the scope of the project."		
38	3.11.11.5 Equipment Maintenance Strategies	Equipment maintenance strategies shall be specified for all equipment. The minimum data requirement for maintenance strategy is.	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format		ореп	Pass all OEM recommendation for O&M	build con information	SAP Maintinance pload it guidelines and will spend provide technical direction during twhich time axecution to		
39	2.11.11.5 a	Tag Number of equipment.	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format		Closed	Marafiq assigns TAG/SAP details, GE updates DWGs, per RFP, GE confirms compliance to SOW in RFP				
40	3.11.11.5.b	Tag Description of equipment - following the Marafiq standard	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	-do-	closed	see 39				
41	3.11.11.5.c	Equipment Type - following the Marafiq standard	GE has maintenance schedules developed for its equipment installed, documents are delivered in	GE has maintenance schedules developed for its equipment installed, documents are delivered in	-do-	closed	see 39		r at a		
42	3 11,11 5.d.	Discipline of equipment - following the Marafiq standard	standard OEM format GE has maintenance schedules developed for its equipment installed, documents are delivered in	standard OEM format GE has maintenance schedules developed for its equipment installed, documents are delivered in	-do-	closed	see 39	SALTHE WILL	200		لياه بلاد
43	3.11,11.5.e.	Maintenance Task Name	standard OEM format GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	standard OEM format GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	-do-	ciosed	see 39	A (P.O. Ben / 1921)	1-111/ (6) (11W/)=1		3 MARA
44	3.11.11.5.f	Maintenance Task Description	GE has maintenance schedules developed for its equipment installed, documents are delivered in	GE has maintenance schedules developed for its	-do-	closed	300 39	Ne.V		4	PROCURE



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45	3 11 11 5 g	Spare Parts required - linked to the Spare Parts offer	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format		closed	see 39					
46	3.11.11.5.h	Special Tools required - linked to the Spare Parts offer	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	-do-	closed	see 39					
47	3.11.11.5.	Task Frequency	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM formal	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	-do-	closed	see 39					
48	3.11.11.5 j	Man hours required - based on task execution only	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	-do-	closed	see 39					
49	3.11.11.5.k.	Failure mode name - related to the maintenance task	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	-do-	closed	see 39					
50	3.11.11.5	Failure mode description - related to the maintenance task	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	-do-	closed	see 39				1	
51	3.11.11.5.m	MTBF of failure mode - related to the maintenance task	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	-do-	closed	399				<u> </u>	
52	3.11.11.5.0	Consequence of failure - specific to the Marafiq context	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	-do-	closed	see 39		TOF.		1.2.21	
53	3 11 11.5,	The maintenance strategies including all the above information shall be delivered in the format defined in the Marafiq Document Control Standards, A covering report detailing and explain the analysis and development of the Maintenance Strategies shall be included as a project deliverable.	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	GE has maintenance schedules developed for its equipment installed, documents are delivered in standard OEM format	Acceptable, Bidder shall comply the Marafiq Standard and SAP requirements	Open	Pass all OEM recommendation for O&M	Fc fol fol 1- kos sy 2- inc Mi # wi 3- inc Mi # 4- ec c.	AP requirement or 'new project' as low SAP Function cation for new stem. Equipment's list lude 'Part #, odule #, MFN, Tag stc.' and linked th function location Bill of material lude 'Part #, odule #, MFN, Tag stc.' for each uipment. OEM manual to eate SAP PM ogram.	GE will provide all relative OEM Maintinance guidelines and will provide technical direction during the project execution to answer questions relating to Maintinance related to the scope of the project. SAP requirement For "new project" as followed	O.K. Noted	
54	3.11.11.6. Maintenance Task Description	Maintenance Task descriptions should include sufficient information and be described in sufficient detail to permit the safe, effective and efficient execution of the task to the required quality. Task descriptions should be broken down into suitable steps and these steps assigned to appropriate technical skill groups, Mechanical, Electrical and Instrumentation for example. Task descriptions should include the required safety precautions needed to adequately isolate, immobilize and make safe the equipment in question. It is not expected that the original equipment manufacturer will be able to identify specific isolation points, it is acceptable to note that isolation and or immobilization must take place and make allowance for the required isolation or immobilization point information to be entered by the engineering or system integration contractor. Task descriptions should include specific quality criteria for the inspection, maintenance or repair work detailed in the task, information such as maximum permissible vibration or wear allowance or other criteria such as flubricant condition shall either be included or have specific cross refernces to a location in the Operation and Maintenance Manual where the information can be directly found.	GE provides recommended maintenance and guidelines for most equipment supplied as part of the O&M manuals that will be shared with Marafiq for equipment supplied.	GE provides recommended maintenance and guidelines for most equipment supplied as part of the O&M manuals that will be shared with Marafiq for equipment supplied.		Closed						
55	3.11.11.7 Documentation Requirements	The minimum data required for Maintenance Strategies as detailed above (2.3) shall be documented following the appropriate Marafiq standard format for entry into the SAP system and Document relating to Maintenance Strategies shall be formally transmitted to Marafiq no later than the specified dates detailed in the Project Plan. This requirement shall include hardcopy and soft copy originals documentation, in the formats defined in Marafiq Document Control Standards, at various stages in the project, for example Concept, FEED, IFC and As Built atc.	GE-designed equipment will have drawings issued per the GE standard (Unigraphics). Interconnect piping, cable routing, etc, can be done in the Micro Station format.	GE-designed equipment will have drawings issued per the GE standard (Unigraphics). Interconnect piping, cable routing, etc. can be done in the Micro Station format.		Closed						







SR	3 12. Applicable Codes,	The Works shall be carried out in accordance with the relevant	30 - 30 (COL) 11-			Closed	GE Complies with RFP		1	1	1
50	Standards & Specifications	Standards and Codes				Diodou			1		
		The Codes and Standards listed below shall be considered as an integral part of the Scope of Work, Where discrepancy / inconsistency exist between these Codes and Standards, the most stringent application shall govern. Discrepancy shall be brought to the attention of Marafiq Representative prior to start of the activity. The Contractor shall ensure that the requirements of the Standards are compiled to, and that all applicable material and design requirements. tests, inspections and other requirements are compiled. Royal Commission Standards Royal Commission Standards Royal Commission Standards Regulations are to be followed for the execution of the Project wherever applicable, unless Otherwise specifically mentioned in the Scope or Specifications. Comply with the applicable provisions of the codes and standards of the following Organizations: OSHA OCCUPATIONAL SAFETY AND HEALTH ASSOCIATION ASSO SAUDI ARABIAN STANDARD ORGANIZATION ASTM AMERICAN SOCIETY OF TESTING AND MATERIALS AWS AMERICAN WELDING SOCIETY ANSI AMERICAN NATIONAL STANDARDS INSTITUTE NEC NATIONAL ELECTRICAL CODE									
		ASME AMERICAN SOCIETY OF MECHANICAL ENGINEERS ASME AMERICAN SOCIETY OF MECHANICAL ENGINEERS									
57	3.12.14.2 ROYAL COMMISSION MYAS GUIDE SPECIFICATIONS	All materials and equipments furnished in accordance with this specification shall also comply with tatest edition of the following sections of the RC MYAS guide specifications. Refer to the tables in pages 37 -35				Closed	GE Complies with RFP				
58	3.13Duration of the Contract	The duration of the contract for the total completion of the Project will be Thirty Six (36) Gregorian months from the Notice	Bidder Takes Exception, final Schedule is based on exact option and shutdown schedules	Bidder Takes Exception, final Schedule is based on exact option and shutdown schedules.	Acceptable subject to the condition that bidder shall plan the rehabilitation of each GTG unit	Closed	closed, GE to accept Marafiq Comment				
		to Proceed. This duration shall include design & approvals, Procurement, Construction, Obtaining permits, Installation, & Testing and Commissioning, and O&M Manual submission, including integration with the existing or new systems/projects. The contractor shall recommended the Maximum shop prefabrication is required to minimize field erection labor and provide specific details of field tasks required to erect the Equipment.			under planned outage. Outage plan for each GTG shall be mutually agreed between MARAFIQ and GE to cope up with the project schedule.						
59	3.14 Documentation for Marafiq Review & Approval	Refer to pages 39 - 42				Closed	GE Complies with RFP				
60	4.A.1.1.L	Fitting of instruments of supply & return lines.	Bidder will specify the instruments supplied and fitted	Ridder will specify the instruments supplied and	Acceptable Cineari	Closed					
61	4.A.1.a1)	Marafig reserves the right to witness all tests, Contractor shall	The second state of the se	fitted	riospiciale, orosos.	Closed	GE Complies with RFP		-		
62	4.A.1.b2)	give advance notice to the scheduled test. Upon completion of the installation and prior to final	Testing will be done in accordance to cooling water	Testing will be done in accordance to cooling	Acceptable Closed.	Closed			-	4	-
02	9.0.10.27	acceptance, each equipment/ unit shall be tested to the complete satisfaction of Marafiq. Shall provide all test instrumentation, equipment and accessories necessary for demonstration and putting equipment into operation. Before commissioning, the Contractor shall submit all necessary calculation & performance curves; relay setting and coordination curves to Marafiq for approval.	system requirement.	water system requirement.				i.			
63	4 A.1.dAcceptance Criteria	Operation and test run of each GTG's "Turbine and/ or Generator Radiator water cooling skid" as one package unit, to ensure that cooling water temperature difference shall maintain at least 6 "C continually for two months (July & August) during peak summer season and having been successfully run under various combinations of GTG loads, ambient temperature and relative humidity. The Cooler that shall capable of providing 100% of the cooling needed at worst scenario. Reduced lube oil temperature and increased unit output.	GE does not want to delay COD of a machine based on uprate completion being in 6 months before summer peak temperature times. GE will do the demonstration test for each cooling water module during the peak temperatures of the summer, but did not want to delay operation of the machine if outage was completed earlier. Acceptance shall be based on the technical specifications in Bidder's Proposal and Technical Clarifications	GE does not want to delay COD of a machine based on uprate completion being in 8 months before summer peak temperature times. GE will do the demonstration test for each cooling water module during the peak temperatures of the summer, but did not want to delay operation of the machine if outage was completed earlier. Acceptance shall be based on the technical specifications in Bidder's Proposal and Technical Clarifications		Closed					
		inviscos isce on temperature and increases one cotput.				1					4
		No effect on emission or fire temperature.						4			



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65	4.A.2.2.2.3.b	Provide new motor starters in the MCC for the new off-base	Exception, scope calls for new MCC supply	Exception, scope calls for new MCC supply	Not Acceptable of Execption, Hence the	Closed	closed, GE to accept			1	
		industrial cooling modules, for installation on the existing two gas turbine generator units including engineering, material, labor and documentation. The field modification shall involve removal of existing motor starters (on existing turbine & generator radiators) including number of spare motor starters that will be needed by the installation and replace it with new motor starters to suit for the new turbine and generator radiators installation. Installation of power supply and all other needed for the proper operation of the motors based on the new locations. Each MCC to include vertical sections of GE MCC's with the following motor starter units.			Bidder shall Supply new MCC along with Switch gears and Starter to meet out Proposed supply Radiator module/Cooling Water Module.		Marafiq Comment				
66	4,6,2.2.2.4,6	Interface and integrate GTG radiator process signals (temperature signals) to existing GE Mark-V control system. Process signals shall be configured in Mark-Vle and associated HMI including the graphic modification and development of graphic pages. Spare I/O will be utilized for interfacing and integration of cooling water inlet and cooling water outlet temperature signals for each GTG radiator.	Exception, new Mark Vie is being proposed	Exception, new Mark Vie is being proposed	Acceptable subject to the condition that bidder shall interface and integrate GTG radiator process signats (temperature signats) to new Mark-Vie system for remote monitoring	Closed	closed, GE to accept Marafiq Comment				
67	4 A.2.2.2.4 j	Cooling Water Module radiator shall have facility for automatic filling of water in header tank. The Contractor shall provide all required instrumentation for automatic filling of water to header tank of radiator.	allow injection of chemicals to the coolant. This will	GE proposes a 5 gallon dosing pot for the module to allow injection of chemicals to the coolant. This will allow the proper coolant chemistry. To fill the module through the surge tank, water supply piping to the surge tank will be added.	made available for topping up the Cooling	Closed	GE Complies with RFP				
68	4 A.2.2.2.7.f	Installation of all power and control cables and grounding conductors for grounding and cathodic protection, if necessary. Joints are not allowed in cables.	Clarification, for the Earthing cable jointing/clamping/cad welding should be allowed	Clarification, for the Earthing cable jointing/clamping/cad welding should be allowed	Acceptable Closed	Closed					
69	4.8 INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8	25ppm Nox for gas fuel 80ppm Nox for liquid fuel Unit starts on liquid fuel and does not to baseload. Typically in turndown conditions. Only baseload on liquid fuel IF they do not have Gas Fuel	Please Refer to applicable Mechanical Clanfications For the NOx limits on each Fuel/Configuration	Please Refer to applicable Mechanical Clarifications For the NOx limits on each Fuel/Configuration	Acceptable. Glosed.	Closed					
70	4.B.2.A1. OPTION - 1	Centralized Water Injection Package to control the NOX on the primary Fuel (Sales High Pressure Gas) and Backup Fuel (Light Fuel Oil) as per environmental control RCER to manage emissions and discharges, the RC Requirement less than 80 PPM in Variance of load condition, complete with all required auxiliary and accessory equipment, instrumentation, controls; and utility connections, DM Water Transfer, Storage and Distribution.		Water injection is not centralized, each GTG will have there own skid	Noted. Subject to the space availability and fitment of new individual water injection skid dedicated to each GTG into existing available space. Centralized DM Water Transfer, Storage and Distribution is envisgaed for this project. Bidder to comply the requirement as per RFP.	Closed					
71	4.B 2.A., 2	The Contractor shall as part of his full responsibility and scope, check the ratings and/or sizes and/or quantity of systems components whose ratings or sizes are specified in the Contract documents. When this check indicates that the specified ratings or sizes are not adequate then the Contractor shall make the necessary changes. The Contractor shall also check and verify every requirement, aspect and detail necessary for interfacing, coordinating and integrating with existing systems and equipment. This will require the part time or full time presence on site of contractor personnel to do the required extensive research of existing design documents. A comparison chart of indicated and proposed ratings will be made with full justifications and submitted to MARAFIQ for approval before implementation.	Clause should apply to new equipment being supplied under this contract, existing equipment in plant will not be covered.		Acceptable Glosed:	Closed					
72	4 B 2 A 3	Work shown upon the drawings and not mentioned or described in the Specification and work described in the Specification and not shown on the drawings will be held to be included in this Contract.	GE will execute on designs and equipment specifically defined in the contract. Additional work or scope identified will be handled as change orders.	specifically defined in the contract. Additional work or scope identified will be handled as change	Noted and Closed.	Closed					
73	4.8.2 G. 1	Mirror modifications to existing as-built drawings shall be shown on originals obtained by the Contractor from MARAFIQ files.	GE supplies modification and ordering drawings for	orders. GE supplies modification and ordering drawings for new equipment.	Accepatble subject to the condition GE shall update, modify existing drawings affected by this project.	Closed	closed, GE to accept Marafiq Comment				
74	4 B.2 G.3	New drawings shall be similar to existing "like" drawings in size, content and format. MARAFIQ drawing numbers shall be assigned in a continuation of sequence of drawing numbers for existing sub - sets into which the new drawings must be integrated.	new equipment. GE drawings are per GE design standards, If additional headers are needed those can be added	GE drawings are per GE design standards, If additional headers are needed those can be added	Acceptable.Closed.	Closed		N.	E has complied larafiq Standard rawing format as per enclosed template	No response from Ws GE	This was already discussed on the meeting and closed, GE will follow Marafiq DWG Template
75	4.5 2 G. 4	When the design work is finished for a particular facility or installation, the entire set of drawings, including new drawings, shall have the same organization and cohesiveness as before the design work started.	Bidder Takes Execption GE Drawings will be supplied per GE Standards	Bidder Takes Execption GE Drawings will be supplied per GE Standards	Not acceptable. GE has to add addiational headers as required to the same organization and cohesiveness for all drawings of the facilities.	Closed	Marafiq to provide template	att	Please find with ached the Marafiq itandard Format.	No response from M/s GE	GE confirms compliance to SOW based on templates
76	4 B 2 H	The Contractor shall be responsible for research to identify MARAFIO documents necessary to the work but not included with the contract documents. The Contractor shall also be responsible for retrieval of these documents refernce drawings furnished with this contract shall not be considered as the total quantity of existing drawings required for the detailed design.		Marafiq Shall provide Drawings Requested by GE and not available in the Library accessible by GE		Closed					a second
77	4.B.B (OPTION- 1).1.1 — Contract Documents	Terms and Provisions., and drawings etc.) are correlative, complementary and mutually explanatory, and any work required in one document and not mentioned in another shall be performed to same extent and purpose as though required	Bidder's Technical Document, Pre Bid - Post Bid Clanfications shall prevail	Bidder's Technical Document, Pre Bid - Post Bid Clarifications shall prevail	Not acceptable.Requirements of RFP,Tender condition shall prevail.	Classed	RFP with all clanifications/deviations shall be part of the contract				WARAFI MARAFI
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PROCUREMENT & CONTRACTS DEPT.

10	4 B.8 (OPTION- 1) 13 Scope of Work	The new & unified Royal Commission Environmental Regulations (2010) for Jubail and Yanbu is being implemented by Maraliq and as a general policy of the Management the Regulation is to comply with RC Regulations to control the Nox Emission from the Gas Turbine units.	For this Option, 1 x Water injection per GT will be provided.	For this Option: 1 x Water injection per GT will be provided	льсерівше Сіцэед.	Closud					
10		The scope of work is EPC includes detailed engineering design, supply, procurement, installation, testing and commissioning to established satisfactory operation of water injection system for frame 7E GTG units # 1 to 8. Contract shall verify if the system installation is required new tank or can be utilize the existing water tank from STG plant.									
		The Water injection package specification given for the reference only this unit caters for the GTG unit -9. The bidder shall provide the Centralized Water injection package to satisfy the demand of supply to GTG-1-8 simultaneously and this package includes the Storage and Distribution. The Demineralized water input shall be taken from the STG 1-4 & 5-6 Storage and Distribution network. This unit shall locate outside the GTG building, Hence the Space is the constraint. The water injection system shall include but not limited to the following:									
79	4.B.B (OPTION- 1).1.3.3.2.3.3.3.4	Sufficient local instrumentation shall also be provided for maintenance and operational use.	Contractor will define the instrumentation supplied	Contractor will define the instrumentation supplied	OK, Noted. The bidder shall full fill the project requirements against approval from Marafig	Closed	similar to GT9				
80	.B.B (OPTION-1).1.3.3.3.2	documentations for Marafiq approval such as schedule engineering, design, drawings, QA/QC plan & safety plan etc.	GE SUPPLIED EQUIPMENT/ DRAWINGS/DOCS/ DESIGN SHALL NOT BE FOR CUSTOMER APPROVAL, SUCH REQUIREMENT MAY DISTURB PROJECT EXCUTION	GE SUPPLIED EQUIPMENT/ DRAWINGS/DOCS/ DESIGN SHALL NOT BE FOR CUSTOMER APPROVAL, SUCH REQUIREMENT MAY DISTURB PROJECT EXCUTION.	Not Acceptable, The bidder shall understand that design documents and drawings for GE propentory items not required for approval. Applicable for other GE equipment(design drawings/documents and standards) and Rest of the non properitory GE items, equipment are applicable and contractor shall provide all design documents and drawings for review and approval.	Closed	see comment	Documents finctude General arrengement DWGs, Site Layout, Schematic/P&ID markups, typically required for O&M and installation			
81	4.B.B (OPTION- 1).1.3.3.3.A4.	Design Supply, fabrication & installation of water injection pumps skid mounted with all accessories, equipments & fittings inside the GTG building as shown on the reference drawing # 00004-ME-A3-217	Water Injection skid will per GE design practices and methods. , 0	Water Injection skid will per GE design practices and methods D	Acceptable, Closed.	Closed					
82	1.B 6 (OPTION-1) 1 3 3.4.2	Contractor shall prepare and submit the required documentations for Marafiq approval such as schedule engineering, design_drawings, OA/OC plan & safety plan etc.	GE designs are per GE design practices and methods. These drawings will be provided at end of job.	GE designs are per GE design practices and methods. These drawings will be provided at end of job.	Acceptable, Closed.	Closed					
83	I.B.B (OPTION-1).1.3.3.4.5	Contractor shall update the existing drawings, Q&M Manuals including new equipment catalog information, settings, testing	New drawings that replace existing drawings will be provided with cross references to existing drawings.	New drawings that replace existing drawings will be provided with cross references to existing	Acceptable, Closed.	Closed					
84	B.B (OPTION-1).1.3.3.4.7	certificate, as-built drawings. It shall be the Contractor's responsibility to locate and protect all underground and exposed structures near the project perimeter.	DISCUSS AND AGREE DETAILS WITH MERAFIQ PRIOR TO BID SUBMISSION.	drawings. DISCUSS AND AGREE DETAILS WITH MERAFIQ PRIOR TO BID SUBMISSION.	Noted: However, RFP/tender condition prevails.	Closed	mutually agree on relocation if needed, GE to add unit rate for such relocation work, along with expected time				
85	B.B (OPTION-1).1 3.3.4.8	The Contractor shall relocate any utility which obstructs the execution of the work upon concurrence and approval by MARAFIQ	Contractor does not include any provision for relocation of utilities, unless otherwise specified.	Contractor does not include any provision for relocation of utilities, unless otherwise specified.	Acceptable subject to the condition of mutual agreement between MARAFIQ and EPC contractor for above ground and underground utility	Closed	closed, GE to accept Marafiq Comment				
86	4.8.8 (OPTION- 1).1 3.3.5.A5.	Design, Supply and installation of the Grounding system.	Contractor will supply new Grounding for the new equipment and tie in to the existing system, no provision has been made to rectify issues with existing Grounding System	Contractor will supply new Grounding for the new equipment and tie in to the existing system, no provision has been made to rectify issues with existing Grounding System	Acceptable, Closed.	Closed					
87	4 B B (OPTION- 1) 1 3 5 A. c.	Supply and install a remote control station (Push button station) near new location of Pump.		Remote control station (Push button station) will be provided with DM Water Tank Pump Only	Acceptable, Closed.	Closed					
88	4.B.B (OPTION- 1),1.3.3.5.A.g.	Supply and install all necessary underground PVC conduits, hot dip galvanized metallic conduct for cables laying.	Only above ground cables considered	Only above ground cables considered	Underground cables are required for centralized DM water Storage Tank, Pump. Bidder shall include supply and install all necessary underground PVC conduits, hot dip	Closed	closed, GE to accept Marafiq Comment				
89	4.8.8 (OPTION- 1).1.3.3.5.Aj	Updating the existing drawings and as built installation Drawings. Operation and Maintenance manuals including new equipment catalog information, settings, testing certificate, as built drawings.	Updates to As Built DWGs to be provided for New Equipment supplied. Operation and Maintenance manuals for new equipment only catalog information, settings, testing certificate, as built drawings.	Updates to As Built DWGs to be provided for New Equipment supplied. Operation and Maintenance manuals for new equipment only, catalog information, settings, testing certificate, as built drawings.	galvanized metallic conduct for cables Acceptable. Closed.	Closed					
90	4.B.B (OPTION- 1).1 3.3.6 1.2.	Monitoring and control system of the Cathodic Protection system shall interface with the existing monitoring & control	Marafiq to provide information on existing system	Marafiq to provide information on existing system	Noted, MARAFIQ shall provide the information of existing CP.	Closed	Marafiq to provide information on existing				
91	4 B.B (OPTION- 1).1.3.3.6.2.5.	system. The Anode system shall provide protection against corrosion for a minimum of 40 Years.	Bidder takes exception for guarantee on design life	Bidder takes exception for guarantee on design life	for new anode system supplied by the	Closed	GE accepts RFP condition				
92	4.B.B (OPTION- 1).1.3.3,10.1	MARAFIQ reserves the right to witness all of testing and inspection activities per approved plan. Test records shall be submitted for the entire system.	Marafiq should submit to GE request for special witnessing, and get agreement between Marafiq and GE Customer travel would be at customer expense.	Marafiq should submit to GE request for special vintnessing, and get agreement between Marafiq and GE Customer travel would be at customer expense.		closed					
93	4.B.B (OPTION- 1).1.3.3.10.2	The contractor shall carry out all on-Site inspection and testing of the entire system under the scope of supply. The MARAFIQ shall have the right to reject any part of the work reasonably found unsatisfactory or not acceptable on the basis of results of such inspection and testing.	Marafiq as defects.	The rejections shall be agreed between GE and Marafiq as defects.	Acceptable. Closed.	Closed					عالياهاليا
94	4.B.B (OPTION-2).2.b)	The engineering and design responsibilities, under this contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/ drawings by utilizing technical documents from the Owner's files	GE design is based on GE Design practices and methods Please clarify the intent of the statemnet in this line.	GE design is based on GE Design practices and methods Please clarify the intent of the statemnet in this line.	GE shall obtain , retrieve the required design, technical information , details of existing GTG from MARAFIQ documentation centre.	Closed	closed, GE to accept Marafiq Comment	SHEET	THE WITE HAVE not played	1911/400 P	MARA Distribution of the procure



95	4.B.B (OPTION- 2).4.4.5. Inspection and testing	Except GTG-3, MARAFIQ shall have the right to reject any part of the work reasonably found to be unsatisfactory or not acceptable on the basis of results of such inspection and	GE does not guarantte emissions at 0% load. At Peak additional evlauation is required to ensure emissions compliance at Peak load.	GE does not guarantte emissions at 0% load. At Peak additional evlauation is required to ensure emissions compliance at Peak load	Acceptable, Closed,	Closed			
96	4.B.B (OPTION- 2),4.4.6 Acceptance Criteria	Gas Turbine Generators (für GTG 1 to 8) to Improve Heat Rate & Assurance with supporting evidence for the higher reliability	GE needs pre outage performance testing to be able to deomonstrate post outage improvement.	GE needs pre outage performance testing to be able to decomonstrate post outage improvement.	Noted. However, RFP/tender condition prevails. GE is responsible for conducting of pre-outage performace testing.	Closed	closed, GE to accept Maratiq Comment		
97	4.8.8 (OPTION-2).4.4.6.1	achieved through advanced technology. The vendor shall provide the Best Technology to Control the Nox Emissions below 80 ppm as per RC Environmental regulatory and Nox performance must be guaranteed from 0 till Peak Load to maintain Nox < 80 ppm from Bypass Stack and HRSG Stack.	GE does not guarantte emissions at 0% load. At Peak additional eviauation is required to ensure emissions compliance at Peak load.	GE does not guarantte emissions at 0% load. At Peak additionat eviauation is required to ensure emissions compliance at Peak load	Acceptable, Closed	Closed			
98	4 B B (OPTION-2).4.4.6.4	By using uprated material, Cooling System, IGV and sealing system Generator output shall be increased as per OEM mentioned on the uprate proposal and study shall be made to confirm no any effect on the Generator Winding and no increase on the exhaust temperature beyond 590 °C.	Listed uprates will increase the GT output, GE confirmed in technical clanfications the consideration for 590 °C exhaust temperature.	Listed uprates will increase the GT output, GE confirmed in technical clarifications the consideration for 590 °C exhaust temperature.	Acceptable, Closed	Closed			
99	4.C 3 2.h	comply with IEC61508/61511 and is certified by third party such as TUV. GE needs to confirm how they will meet these	MarkVie is certified by EXIDA	Mark Vies Capable Panel can achive these SIL levels with compliance to IEC 61508. MarkVie is certified by EXIDA. MarkVie can comply IEC 61511 requirements, however complete Loop compliance for IEC61511 is not GE scope	Acceptable. Closed	Closed			
100	4.C 3.5.16	Contractor shall warranty the complete MARK Vie replacement equipment under scope of supply for 1 year. All upgrades and software patches shall be provided with clear written instruction to be implemented by MARAFIQ during the period of warranty and after at no cost to MARAFIQ.	be supported, however any item above the base scope defined in Bidder's Technical Proposal will be	MarkVle Software Version updates and patches will be supported, however any Item above the base scope defined in Bidder's Technical Proposal will be Extra Work.	Acceptable. Closed.	Closed			
101	4.C.3.5.36	The Contractor shall study the SOE (sequence of events) configuration of GTG 1-8 and GTG-9 SOE configuration in GTG1-8 and GTG-9 needs to be studied for all associated electrical protection signals trips and such shall be provided in new upgraded Mark Vie. All additional Input/Outputs hardware. Terminal Blocks, Modules, Interposing Relays and wiring shall be provided for all associated electrical protection signals causing the trips. Accordingly UCS SOE shall be modified by ABB to meet the Mark Vie upgrade. The Contractor shall provide the detailed technical description along with BOM for SOE upgrade of Mark V to Mark Vie in their bid document.	MarkVIe has SOE built into ControlST. What additional signals from elctrical protection will be wired? Need More clarity on the requirement	MarkVie has SOE built into ControlST. What additional signals from eletrical protection will be wired? Need More clarity on the requirement	PHA and HAZOP Study was never performed since from the installation of Gas Turbine Generator. MARAFIO did not have CAUSE and EFFECT diagram developed for the present set up of gas turbine equipment. However during UCS upgradation, SOE points were configured and developed in Mark-V and UCS. There are no back up documents and basis available for present equipment configuration. All contributing points for SOE which are responsible for causing trip actions must be included for post trip review analysis. All such points (additional input/Outputs hardware, Terminal Blocks, Modules, interposing Relays and wing shal be provided for all associated electrical protection signals causing the trips). Accordingly these new SOE points which are being exchanged through serial Modbus to UCS shall also be modified and configured by ABB to reflect all the changes in UCS so there is no discrepancies of SOE generated. Bidder shall include complete LOOP checking activity for direct trigger SOE points and including associated contributing points for SOE.	Closed	ctàrried		
102	4.C.3.5.43	The Contractor shall provide extended support for Mark Vie	MarkVle Software Version updates and patches will	MarkVie Software Version updates and patches		Closed	GE to include 10 years		
		System software versions including following but not limited	be supported, however any item above the base scope defined in Bidder's Technical Proposal will be Extra Work.	will be supported, however any item above the base scope defined in Bidder's Technical Proposal will be Extra Work.	that Microsoft security validation patch and third party virus scanner software updates are alos included.		(patching server)		
103	4.C. 3.5.44.	The Contractor shall study IPF (Instrument Protective Function) for retroliting of proposed Mark Vie control system in compliance with Standards IEC61508 and IEC61511 for existing GE Frame 7E and 7EA gas turbine. Actual SIFs for critical protection loops including SIL assessment for existing Gas Turbine Generators shall be determined by the contractor based on the site equipment configuration and accordingly all retroliting work shall be performed to meet the requirements of IEC61508 and IEC61511.	What additional signals from electrical protection will be wired? Need More clarity on the requirement	MarkVle has SOE built into ControlST,	PHA and HAZOP Study was never performed since from the installation of Gas Turbine	Closed	provide unit rates for the implementation of the recommendations in HAZOP and SIL study, (provide T&M details)		بالياه بالدر
	4.C.3.5.45	The Contractor shall conduct/perform HAZOP studies in	GE complies as applicable to the agreed to scope in	GE complies as applicable to the agreed to scope	Acceptable Closed	Closed			MARAF



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105	4 C 3 5.45 A	Hazard and risk assessment	GE complies as applicable to the agreed to scope in	GE complies as applicable to the agreed to scope	Acceptable, Closed.	Closed	1		_	
			the contract.	in the contract.	12/25/27/2	Downer.				1
106	4.C 3 5.45.B	SIL assessment	GE complies as applicable to the agreed to scope in the contract.	GE complies as applicable to the agreed to scope in the contract.	Acceptable, Closed,	Closed				
107	4.C.3.5.46	Above, "A" & "B" SHALL be carried out on hazardous GTG's processes and its associated equipment. It shall result in	GE complies as applicable to the agreed to scope in the contract.		Acceptable, Closed.	Closed				
108	4 C 3 5.46 46.1	A description of each identified hazardous event and the	GE complies as applicable to the agreed to scope in		Acceptable, Closed.	Closed				
109	4 C 3.5.46 46.2	factors that contribute to it: A description of the consequences and likelihood of the event;	the contract. Is SIL certification required?	in the contract. Is SIL certification required?	SIL certification is required and mandatory per IEC 61508 and IEC 61511 for legal compliance to HCIS safety and security	Closed	provide unit rates for the implementation of the recommendations in			
110	4.C.3.5.46.46.3	Consideration of conditions such as normal operation, start-up, shutdown, etc.,	GE complies as applicable to the agreed to scope in the contract.	GE complies as applicable to the agreed to scope in the contract.		Closed				
111	4.C 3 5.46 46.4.	The determination of requirements for additional risk reduction	GE complies as applicable to the agreed to scope in	GE complies as applicable to the agreed to scope	Acceptable, Closed.	Closed			12	
112	4.C 3.5.46.46.5	necessary to achieve the required safety; A description of, or references to information on, the measures			Acceptable, Closed.	Closed				1
113	4.C.3.5.46.46.6	taken to reduce or remove hazards and risk. A detailed description of the assumptions made during the	the contract. Is SIL certification required?	in the contract. Is SIL certification required?	SIL certification is required and mandatory per	Closed	provide unit rates for the		4	 1
110		analysis of the risks including probable demand rates and equipment failure rates, and allocation of the safety functions to layers of protection taking account of potential reduction in effective protection due to common cause failure between the different layers.	a are equinositor requires	is the company required	IEC 61508 and IEC 61511 for legal compliance to HCIS safety and security directives.	0.000	implementation of the recommendations in HAZOP study, (provide T&M details)			
114	4.C.3.5.46.46.7	SIL assessment report shall have test frequencies and test procedures for all Instrument Protective functions (IPF) provided.	s SIL certification required?	ls SIL certification required?	SIL certification is required and mandatory per IEC 61508 and IEC 61511 for legal compliance to HCIS safety and security directives.	Closed	provide unit rates for the implementation of the recommendations in HAZOP study, (provide T&M details)			
115	4 C 3 5.46 >	Such studies do not exist in GTG's within MARAFIQ and we need GE (The Contractor) to provide us with.	ls SIL certification required?	Is SIL certification required?	SIL certification is required and mandatory per IEC 61508 and IEC 61511 for legal compliance to HCIS safety and security directives.	Closed	provide unit rates for the implementation of the recommendations in HAZOP study, (provide T&M details)			
116	4.035.5.11		Document Requirements need to define during RFQ stage not at Detailed engineering Phase.GE will provide Standard Controls upgrdae Drawings only.	Document Requirements need to define during RFQ stage not at Detailed engineering Phase GE will provide Standard Controls upgrdae Drawings only.	Acceptable subject to the condition that bidder shall provide following documentation. (1) Critical Infrastructure Protection Documentation. (2) Paper Copies of the HMI Screens, Graphic Display Screens. (3) Modbus Register List. (3) Wring Diagrams. (4) Elementary Drawings. (5) Cabinet Layout Drawings. (6) Network Topology. (7) Bill of Materials. (8) System Manual. (9) Cause and Effect Diagram. (10) Instrument dala sheets and specification. (11) Control Logic Drawing. (12) General specifications for instruments, cables and panels. (13) General arrangement of Mark-Vie Control panel. (14) SIS Documentation.	Closed	item (14) SIS, regardless of SIL deliver with SIS			
117	4.C 3 5.5.2.1	Within forty five (45) days after the Notice of award of the contract, contractor shall submit an inspection and testing Plan,	Inspection and testing Plan will be submitted 60 Days before Installation	Inspection and testing Plan will be submitted 60 Days before Installation	Acceptable, Closed.	Closed				
118	4 C 3.5.5.2.3	for MARAFIC review and approval. The contractor shall carry out all off-Site and on-Site inspection and testing of the entire system. The MARAFIC shall have the right to reject any part of the work reasonably found unsalisfactory or not acceptable on the basis of results of such inspection and testing.	Contractor will carry out tests and inspection on new equipment supplied under this contract, however not entire systems existing on site.		Acceptable subject to the condition that SAT,FAT and PAT	Closed	closed, GE to accept Marafiq Comment			
119	4 C 3 5 5.2.5	The contractor shall report to and work to the schedule requirements of the contract and MARAFIQ work times.	Work Schedule Should Support the Overall project Schedule	Work Schedule Should Support the Overall project Schedule	Acceptable subject to the condition that SAT,FAT and PAT	Closed	closed, GE to accept Marafiq Comment			
120	4 D.2 4.a). Rotor apecification	Rotor length: 7803 mm & total weight of bladed rotor: 50600 kg. All piping should be removed above & side of the turbine & compressor casing.	Final Specifications on the rotor will be available after design phase		Acceptable, Closed.	Closed	manany comment			
121	4 D 2 4 g) Inspection and testing	Except GTG-3, MARAFIQ shall have the right to reject any part of the work reasonably found to be unsatisfactory or not acceptable on the basis of results of such inspection and	GE does not guarantte emissions at 0% load. At Peak additional eviauation is required to ensure emissions compliance at Peak load.	GE does not guarantte emissions at 0% load. At Peak additional eviauation is required to ensure emissions compliance at Peak load.	Acceptable, Closed.	Closed				
122	4 F.2.5.U Acceptance Criteria	testing. Operation and test run of each GTG's with Uprate parts in Turbine modification, to ensure the each Gas Turbine Generators (for GTG 1 to 8) to Improve Heat Rate – 8% FueVMW. And the bidder shall take dismantled Part from modification of the Uprate and Available Capital Spares from Marafiq Ware house in the Parts Exchange Programme.	Guarantees will be part of the contract	Guarantees will be part of the contract	Acceptable, Closed,	Closed				









123	4 G.1.5.5.6.5.6.3.CRemovi ng the old winding and	Recording the winding details - Document the appropriate fields to ensure that the winder can duplicate the winding.	Clarification; The winding must be separated before removing from the stator core	Clarification The winding must be separated before removing from the stator core	Contractor's Clanfication is not clear. As per SoW requirements, Contractor should record	Closed	per GE Clanfication				
	cleaning the core	Key points on recording the winding details a. Winding configuration (lap, concentric, single, two or three layers, etc.) b. Number of slots c. Number of poles d. Number, size and marking of leads e. Tums/coil f. Grouping g. Coil pitch h. Connections i, Coil extension/overhang – connection end j. Coil extension – non-connection end k. Number and size of wires in each coil			the winding details for the required work. There is no valid reason for any deviation for this clause.						
		 Core loss testing – Always use testers well within the manufacturer's recommended operating range. Core loss testers can be useful provided that the same tester at the same setting is always used for each test on a given core. 									
		Key points on core loss testing a. Conduct all tests using the same core tester. b. Make sure the tests are conducted well within the manufacturer's recommended operating range for the tester being used. c. Carry out test (before burnout, after the core has been cleaned prior to rewinding) d. Remember that figures obtained are comparative, not actual losses.									
		a. If the core loss increases by more than 20%: (1) Make sure the settings of the core loss tester have not been changed and repeat the test. (2) If the repeat test confirms the increased loss, repair the core or consider replacing it.									
		Removing the old wining – The varnish and the insulation must be broken down before the windings can be removed from the stator core.									
		Cleaning the stator core in preparation for rewinding – After the old winding has been removed from the core, slot insulation and other debris may remain in the slots. This must be removed carefully to avoid damaging the core.									
124	4 K.2.2.2.2.2.2.E	Use existing embedded and underground raceways/ duct banks and cable racks in MYASPP site wherever possible.	Exception, only usable if Ungrouded trays have proper grounding, to be verified by Marafiq	Exception, only usable if Ungrouded trays have proper grounding, to be ventied by Marafiq	All the required installation including verification of existing facilities, are included in Contractor's scope.	Closed					1
125	4.L.1.3.3.2AVAILABILITY OF SPARE PARTS	The contractor shall guarantee the availability of spare parts of the Metal Clad Switchgears and all related equipment for about 15 years of the equipment life in order to avoid early		d Exception, not all sub components can be guaranteed to remain available	GE to furnish the list of sub-components that can be guaranteed for availability,as specified.	Closed	GE confirms availability of SWGR Spares availability for 15 years				
128	4L1334B	obsoleteness. Design Drawings & Shop Drawings: The contractor shall prepare and submit design shop drawings to MARAFIQ for review and approval. The drawings submittal shall include all engineering and vendor drawings required to implement the job. A drawing control list shall also be prepared for all drawings to be submitted by the contractor. The list shall indicate when each of the drawings will be submitted during the design stage.	EXCEPTION, Shop or prioritory drawing will not be submitted	EXCEPTION. Shop or prioritory drawing will not be submitted	Deviation has not been justified. Shop Drawings shall be submitted, which shall include, as a minimum: 1. Detailed dimensions and weights. 2. Nameplate legends. 3. Bus configuration. 4. Current ratings of buses. 5. Short-time and short-circuit ratings of switchgear assembly. 6. Wiring Diagrams.	Closed	see comment	Documents finclude General arrengement DWGs, Site Layout, Schematic/P&ID markups, typically required for O&M and installation			
127	4.L.1 4.4.8.A. INSTRUMEN T TRANSFORMERS	Current transformer shall be provided with ratios determined by the contractor. Phase designation and polarity shall be clearly marked on each current transformer.	CTs are build in the breakers and will come with the ACB ratings	CTs are build in the breakers and will come with the ACB ratings	should not be a dev	Closed	remova				
128	4 L.1 4.4.8.B INSTRUMEN T TRANSFORMERS	Each switchgear section shall be provided with potential transformers. Potential transformers shall be draw out type, mounted in separate compartments, and shall be equipped with current-limiting fuses on both terminals of the primary. Secondary fusing shall be determined by the contractor. The draw out mechanism shall provide means of disconnecting the primary circuit before access can be obtained to the transformer or fuses.	draw out is an exception to the provised VT and considered not applicable in LV SWG desgin	draw out is an exception to the provided VT and considered not applicable in LV SWG desgin	Accept	Closed					
129	4 M.1.4.4.2.n, Detailed Scope of Work	Assessing the condition and life expectancy of removed ABCB and associated equipment along with recommendation from manufacturer for using the removed ABCB and its components as spare parts for remaining GTG ABCBs.	GE takes Exception to advising Life expectancy	Life expectancy can not be recommended	accept	Closed					
130	4.M.1.6.6.3.a OPERATING MECHANISM	The circuit breaker shall be actuated by a spring operating mechanism.	hydromechanical-spring drive	hydromechanical-apring drive		Closed	The offered "HMB" curcuit braker is a spnng drive, please See page 3 item no 5. This is the spring of the drive, kindly refer to the attached cut sheet.		The attached catalog is applicable for 52 kV and above, and is not relevant to our requirement of Generator Circuit Breaker. GE has to confirm the Generator Circuit Breaker they are offering is actuated by a spring operating mechanism.	No response t Ws GE	rom GE will supply a "HVR-63XS" ABB GCB that confirms to the applicable IEEE C37 013 specifications

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MARAFIQ CONTRACTS DEPT.

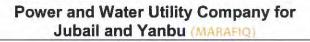
131		The stored energy of operating mechanism shall be sufficient to perform 2 complete close open operations.	The breaeker is O-CO (which is sufficient because the only combined operation you have to do is CO (close into a short circuit and open again)).	The breaeker is O-CO (which is sufficient because the only combined operation you have to do is CO (close into a short circuit and open again)).		1. GCB which fulfills O-CO-CO is not available 2. There is no relevant ANSI or IEC standard concerning the generator circuit breakers which requires this 3. The relevant standard for Generator Circuit Breakers is IEEE C37.013 4. The ABB breakers provided for plants in Saudi Arabia were not required O-CO-CO.	We find that IEEE C37.013 specifies C0-30 min-C0 as Operating Duty. (Please find attached snapshot). GE to clarify the discrepancy, and support their proposal of Operating Duty with extract of relevant standard. Please ensure that the Standard being referred is applicable for 15 kV Generator Circuit Breaker		No response from Wa GE	GE will supply a "HVR-63XS" ABB GCB that confirms to the applicable IEEE C37.013 specifications
132		Reliable mechanical position indicator to display open and close position of the circuit breaker	NOT APPLICABLE	NOT APPLICABLE	Closed	GE confirms compliance to SOW per RFP				
133	4.T.2.2.3.1.* General	Sizing and application calculations for all components	we shall provide the transfomer with similar rating and no calcualtion is assumed to be required	we shall provide the transfomer with similar rating and no calcualtion is assumed to be required		Specification Sheet will be submitted with typical details for such transformaer. (ie: rating, impendance, etc.)	Please confirm Percentage Impedance value of the new transformer will match with that of existing transformer		No response from Ws GE	It was already confirmed that Transformer will be with similar rating impedance.
134	4. – IV A REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8	Ambien Temprature 60C	The Maximum Ambient Temprature for design shall be considered as 55C.	With reference to discussion on 01NOV2015 on sile, the proposed cooling water module will fit in available space of approximate 7000mm x 20000mm and meet all other criteria discussed throughout technical clarifications	OPEN			The Maximum Ambient Temprature shall be considered as 55C, per discussion on 01NOV2015 on site.	O.K, Closed	



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Contract PO No. 7200026909

Gas Turbine Generators Rehabilitation by Replacement of the Major Parts







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C.1 CONTRACT PRICE

Marafiq shall pay to the Contractor the Contract Price, as set out in Table C-1, as compensation in full for the performance of the Work. The Contract price shall compensate for all the responsibilities and obligations of the Contractor under the terms and conditions of this Contract, except as may be otherwise expressly provided in this Contract.

C.2 PAYMENT

Payment will be made within thirty (30) calendar days after receipt of acceptable invoice for each work performed. Each invoice shall be prepared by Contractor in the form and manner requested by MARAFIQ, and shall be submitted on a monthly basis with all supporting documents. If necessary, MARAFIQ may require Contractor to substantiate the invoiced amount. However, in the event MARAFIQ would object to any item or statement contained in any invoice, or to the sufficiency of the invoice and supporting documents submitted in support thereof, MARAFIQ shall be entitled to withhold whole or portion of the invoiced amount to which MARAFIQ objects from the payment or from payment of subsequent invoices. MARAFIQ shall promptly notify Contractor or any such objection and withholding and upon resolution thereof, shall pay Contractor any remaining invoiced amount which is due and payable to Contractor in accordance with the terms and conditions of this Contract. Payment of each invoice shall have evidence of Proponent Department approval prior to making any payment.

No payment will be processed by MARAFIQ unless Contractor furnishes:

- a) an acceptable Performance Bond/Bank Guarantee in accordance with Clause SC-6 of Attachment "B", Special Conditions and
- Insurance certificate copies (Original Insurance Certificate shall be submitted for verification only) in accordance with Clause GC.51 of Attachment "A", General Terms and Conditions, of the Contract

Contractor shall submit Performance Bond / Bank Guarantee / insurance certificates / and invoices with supporting documentation to:



MARAFIO

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For JUBAIL Projects	For YANBU Project				
Attention: Manager, Finance	Attn: Manager, Accounts - Yanbu				
Power & Water Utility Co. (MARAFIQ)	Power & Water Utility Co. (MARAFIQ)				
Level 2, Room 210, MARAFIQ HQ.	Admin. Bldg.				
PO Box 11133, Jubail Ind'l City, KSA	PO Box 30144, Yanbu Ind'l City, KSA				

C.3 CURRENCY AND MANNER OF PAYMENT

Payment shall be made in Saudi Arabian riyals to Contractor by bank electronic account transfer, net 30 days from the date of acceptable invoice.

C.4 WITHHELD AMOUNTS

Any amounts payable to Contractor hereunder may be withheld, in whole or in part, MARAFIQ if:

- (a) any claims are filed against Contractor by MARAFIQ or third parties or if MARAFIQ is required to withhold such amounts by the Government of Saudi Arabia pursuant to the laws and regulations of the Kingdom; or
- (b) the Contractor is in default of any of the terms or conditions of this Contract; or
- (c) there is reasonable doubt that this Contract can be completed within the time specified or for the balance of the Contract Price then unpaid.

If the foregoing causes for withholding are remedied to the satisfaction of MARAFIQ, the withheld payments shall forthwith be made. If such causes are not promptly remedied after written notice to Contractor, MARAFIQ may rectify the same at Contractor's expense and deduct all costs and expenses incurred thereby from such withheld payments or from any other monies due, or which may become due to Contractor. If the amount of such withheld payments or other monies due to Contractor under this Contract is insufficient to meet such costs, or if any claim against Contractor is discharged by MARAFIQ after final payment is made, Contractor and its guarantors or sureties, if any, shall promptly pay MARAFIQ all costs incurred thereby regardless of when such claim arose or whether such claim imposed a lien upon the Permanent Works or the real property upon which the Permanent Works are situated.

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C.5 ASSIGNMENT OF MONIES

Further to the provisions of the General Condition GC.19 hereof entitled "ASSIGNMENT", in the event that MARAFIQ consents to such assignment of monies, written notice shall be given to MARAFIQ thereof at least ten (10) days before payment is due. Any assignment of monies shall be subject to all proper set-offs in favor of MARAFIQ and to all deductions and withholdings provided for in this Contract.

C.6 RETENTION AND FINAL PAYMENT

Retention of 10% will be applied to the contract value exceeding 100, 000 SR and will be released upon MARAFIQ's issuance of Initial Acceptance Certificate, and Contractor submission of final invoice and valid (unrestricted) final Zakat Certificate.

C.7 DELAY PENALTY

C.7.1 Delay Penalty shall be assessed against CONTRACTOR for failure to complete the PROJECT in accordance with the Initial Acceptance Date as mentioned in GC-41 of Attachment "A". Delay Penalty shall be calculated for each day of delay based on the "Daily Average Cost" (DAC) of the PROJECT.

C.7.1.1 The DAC equals the CONTRACT Price as stated in Attachment "C" divided by the PROJECT Duration (in days) as specified in SC-2 of Attachment "B". That is,

Delay Penalty shall be assessed in three stages as follows:



For each day of delay up through 15 days or five percent (5%) of the PROJECT Duration, whichever is greater, Delay Penalty shall be one-fourth of the Daily Average Cost.



Second Stage

For each day of delay beyond the initial 15 days or five percent (5%) of the PROJECT Duration, and up through the next 15 days or five percent (5%), whichever is greater, Delay Penalty shall be one-half of the Daily Average Cost.

PROCUREMENT &



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Third Stage

For each day of delay beyond the second 15 days or five percent (5%) of the PROJECT Duration, and up through the actual date of Initial Acceptance of the PROJECT, Delay Penalty shall be the Daily Average Cost.

C.7.1.2 The total Delay Penalty assessed against CONTRACTOR shall not exceed ten percent (10%) of the total CONTRACT Price. However, if the portion of the PROJECT not completed by the Initial Acceptance Date does not prohibit full utilization of the PROJECT on this date and does not cause any inconvenience in the utilization of other utility, then the total Delay Penalty shall not exceed ten percent (10%) of the value of the PROJECT not executed as determined by MARAFIQ.

C.7.2 Delay Penalty for Project Portions

If the Project includes more than one (1) Project Portion, as may be indicated in Attachment "D", Scope of Work, of the Contract, the provisions of Sub-paragraphs C.7.1.1 and C.7.1.2 shall be applied separately for each Project Portion.

C.7.3 Liquidated Damages

Liquidated damages "LDS" will be as per Marafiq Terms and Conditions of the subject RFQ and shall not exceed 10% of Contract Price. For the 10% LD for late delivery of individual GTG units will be proportionately reduced by number of units accepted by Marafiq.

For the avoidance of doubt, LD on late delivery of GTG units would be applied on a unit by unit basis based on 10% of the indicated contract value for each of the 9 units.

C.8 TABLE OF PRICES

Payment under this contract is based on the work accomplished as verified by the supervising department and in accordance with the schedule of prices and conditions









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Termination Charges:

Units Covered	Critical Milestone Date	Start Of Manufacturing	Termination Charges
Batch 1 (any 4 GTG units + #9)	1 May 2016	31 May 2016	5% of Batch 1 plus applicable charges as per Clause GC45
Batch 2 (any 2 GTG units)	15 Dec 2016	15 Jan 2017	5% of Batch 2 plus applicable charges as per Clause GC45
Batch 3 (any 2 GTG units)	15 Jan 2017	15 Feb 2017	5% of Batch 3 plus applicable charges as per Clause GC45

The following assumptions shall apply:

- Pay Item A: "Mobilization and Demobilization" representing 5% of the total Contract Price for all 9 units equivalent to Saudi Riyals Twenty Nine Million Eight Hundred Fifty Thousand (SAR29,850,000.00) that is non-refundable in case of Termination of Scope of Batch 2 and Batch 3.
- Pay Item B: "Design and Engineering Services (Including HAZOP)" representing 5% of the Total Contract Price for all 9 units equivalent to Saudi Riyals Twenty Nine Million Eight Hundred Fifty Thousand (SAR29,850,000.00) that is non-refundable in case of Termination of Scope of Batch 2 and/or Batch 3;
- Fifteen percent (15%) of the Total Contract Price equivalent to Saudi Riyals Eighty Nine Million Five Hundred Fifty Thousand (SR89,550,000.00) shall be paid in advance to General Electric in lieu of an unconditional bank guarantee issued by a reputable Saudi Arabian bank;
- 4. No termination charges shall apply if termination occurs before the Critical Milestone dates:
- 5. If MARAFIQ decides to terminate Batch "2" after 15 December 2016, MARAFIQ shall pay termination charges of "5% of Batch 2" plus applicable charges as per Clause GC45;
- Should MARAFIQ decides to terminate Batch "3" after 15 January 2017, MARAFIQ shall
 pay termination charges of "5% of Batch 3" plus applicable charges as per Clause GC45;
 and
- 7. In case of termination of Batch "2" and/or Batch "3", any advance payment nimes in applicable termination charges plus applicable charges under GC 45 shall be issued by wa of a credit note by GE to MARAFIQ for work performed by GE and whatever is involved to Batch "1" completed scope.

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Table 1 Itemized Price and Description, with New Generators:

S/N	PAY ITEMS DESCRIPTION with new	Generators	QTY	UNIT	Unit Rate, SAR	AMOUNT, SAR
Α	Mobilization and Demobilization	ation	1	Lot	29,850,000	29,850,000
В	Design & Engineering Servi	ices	1	Lot	29,850,000	29,850,000
С	HAZOP Studies This shall include of HAZOP studies works as required poor of work and satisfactory	er the Scope	1	Lot	1,482,188	1,482,188
D	GTG Units					
	The fixed prices include all of Contractor's costs of whatever nature both direct and indirect and the accessories, testing, warranty and any other work associated with these fixed price items.				7,844	MARAFIQ MARAFIQ MARAFIQ MARAFIQ MARAFIQ MARAFIQ MARAFIQ MARAFIQUE MENT MARAFIQUE MARAF
	Activities	Rehabilitatio n of the GTG units			the	CONTRACTS OF S
D.1	Cooling Water Radiator skids	1 to 8	8	Lot	3,969,000	31,752,000.00
D.2	Nox Control System -Water Injection	1 to 8	8	Lot	3,098,466	24,787,728.00
D.3	Speed Tronic from Mark V To Mark VIe upgrades	1 to 9	9	Lot	2,646,000	23,814,000.00
D.4	Compressor Assembly & un-bucketed Turbine Rotors Replacement	1, 2, 4,5,6,7, 8	7	Lot	15,846,894	110,928,258.00
D.5	Extendor Parts for Hot Gas Path (32K)*	1 to 9	9	Lot	4,479,254	40,313,286.00
D.6	Full Unit Uprates of GTG					NOT USED/ SCOPE EXCLUDED
D.7	7A6 Generator with Installation **	1 to 8	8	Lot	16,655,791	133,246,328.0
D.8	Replacement of AC/DC Power, Control & Instrumentation Signal Cable	1 to 8	8	Lot	2,304,156	18,433,248.0

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D.9	Replacement of Exhaust Plenum for GTG units	1 to 8	8	Lot	10,184,794	81,478,352.00
D.10	Replacement of GTG Exhaust Shut off and By pass damper Geared motor	1 to 8	8	Lot	451,515	3,612,120.00
D.11	Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type	1, 2,3,4, 7, 8	6	Lot	667,107	4,002,642.00
D.12	600V Draw out metal clad Switchgear	1, 2,4, 7, 8	5	Lot	1,377,918	6,889,590.00
D.13	Generator Breaker Replacement	1, 2,3,4, 7, 8	6	Lot	2,668,690	16,012,140.00
D.14	Hydrogen Control panel					OPE EXCLUDED FOR TOR REPLACEMENT
D.15	Replacement of AVR by digital Excitation system****	1 to 9	9	Lot	1,191,450	10,723,050.00
D.16	Installation of Ventilation fan & hydrogen detectors inside DCC	1 to 8	8	Lot	200,484	1,603,872.00
D.17	Motor Control Center Replacement	1 to 7	7	Lot	1,369,077	9,583,539.00
D.18	Gas Flow meter Replacement	1 to 9	9	Lot	74,165	667,485.00
D.19	Replacement of 4.16kV Switch gear	1, 2,3,4,6 7, 8	7	Lot	1,480,500	10,363,500.00
D.20	Installation of 2 Nos (GTG) Secondary Unit Auxiliary 4.16kV/0.48kV Dry type transformers	1&8	2	Lot	599,189	1,198,378.00
D.21	Gas Turbine Performance Test and Training	1 to 8		lot	Price is imbedded in the rehabilitation activities per Section 5	
E	Inspection, Testing and Commissioning	1 * k	1	Lot	2,538,000	2,538,000.00
F	Performance testing	AFIQ" LC		Lot	Price is imbedded in t	
G	O & M Training (عنوالعقود الله عنوالعقود الله عنوالع	Lating in 19:	1	Lot	2,643,750	2,643,750.00

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	TOTAL FIXED PRICE FOR ITEM A1 (A,B,C,D,E,F,G & H) - Base-1 (Nox Control - Water Injection System) in SAR		se-1 (Nox	59	97,000,000.00
Н	SUBMITTALS, O&M Manuals, Test records, As-built Drawings	1	lot	1,226,546	1,226,546.00



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PROCUREMENT &



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Table 2 Itemized Price and Description with Generator Rewinding

S/N	PAY ITEMS DESCRIPTION with new	v Generators	QTY.	UNIT	Unit Rate, SAR	AMOUNT, SAR
A	Mobilization and Demobilization		1	Lot	29,850,000	29,850,000
В	Design & Engineering Serv	rices	1	Lot	29,850,000	29,850,000
С	HAZOP Studies This shall include carr studies works as required per the Sco satisfactory	A COUNTY OF THE PARTY OF THE PA	1	Lot	1,482,188	1,482,188
D	GTG Units 1, 2, 7, 8, 9					
	The fixed prices include all of Contractor's costs of whatever nature both direct and indirect and the accessories, testing, warranty and any other work associated with these fixed price items.			P.O. Bos / 10271 Riyada / 11477	المراد الله الله الله الله الله الله الله ال	موالياه MARAFIO الشتريات والمقود (قرار) PROCUREMEN
	Activities	Rehabilitation of the GTG units		P. 101022	377 1.1. YYTTYY	San A
D.1	Cooling Water Radiator skids	1 to 8	8	Lot	3,969,000	31,752,000.00
D.2	Nox Control System -Water Injection	1 to 8	8	Lot	3,098,466	24,787,728.00
D.3	Speed Tronic from Mark V To Mark VIe upgrades	1 to 9	9	Lot	2,646,000	23,814,000.0
D.4	Compressor Assembly & un- bucketed Turbine Rotors Replacement	1, 2, 4,5,6,7, 8	7	Lot	15,846,894	110,928,258.00
D.5	Extendor Parts for Hot Gas Path (32K)*	1 to 9	9	Lot	4,479,254	40,313,286.00
D.6	Full Unit Uprates of GTG					NOT USED/ SCOPE EXCLUDED
D.7	Generator Rewinds	1 to 7	7	Lot	19,035,189.71	133,246,328.0

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D.8	Replacement of AC/DC Power, Control & Instrumentation Signal Cable	1 to 8	8	Lot	2,304,156	18,433,248.00
D.9	Replacement of Exhaust Plenum for GTG units	1 to 8	8	Lot	10,184,794	81,478,352.00
D.10	Replacement of GTG Exhaust Shut off and By pass damper Geared motor	1 to 8	8	Lot	451,515	3,612,120.00
D.11	Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type	1, 2,3,4, 7, 8	6	Lot	667,107	4,002,642.00
D.12	600V Draw out metal clad Switchgear	1, 2,4, 7, 8	5	Lot	1,377,918	6,889,590.00
D.13	Generator Breaker Replacement	1, 2,3,4, 7, 8	6	Lot	2,668,690	16,012,140.00
D.14	Hydrogen Control panel				Price is imbedded in D.7 Genera Rewinds	
D.15	Replacement of AVR by digital Excitation system****	1 to 9	9	Lot	1,191,450	10,723,050.00
D.16	Installation of Ventilation fan & hydrogen detectors inside DCC	1 to 8	8	Lot	200,484	1,603,872.00
D.17	Motor Control Center Replacement	1 to 7	7	Lot	1,369,077	9,583,539.00
D.18	Gas Flow meter Replacement	1 to 9	9	Lot	74,165	667,485.00
D.19	Replacement of 4.16kV Switch gear	1, 2,3,4,6 7, 8	7	Lot	1,480,500	10,363,500.00
D.20	Installation of 2 Nos (GTG) Secondary Unit Auxiliary 4.16kV/0.48kV Dry type transformers	1&8	2	Lot	599,189	1,198,378.00
D.21	Gas Turbine Performance Test and Training	1 to 8		lot	Price is imbedded in the rehabilitation activities per Section 5	
E	Inspection, Testing and Commissioning	MARAFIQ SEC	1	Lot	2,538,000	2,538,000

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F	Performance testing	0	Lot	Price is imbedded in rehabilitation activit	
G	O & M Training	1	Lot	2,643,750	2,643,750
н	SUBMITTALS, O&M Manuals, Test records, As-built Drawings		lot	1,226,546	1,226,546
	TOTAL FIXED PRICE FOR ITEM A1 (A,B,C,D,E,F,G & H) - Base-1 (Nox Control - Water Injection System) in SAR			5	97,000,000.00

Price Assumptions:

1. TOTAL FIXED PRICE AFTER GE DISCOUNT should be considered as requested in Bid Parkers unit rates for each Pay Item are provided for the purposes of progress payments only

2. D.6, D.21 and F are deliberately left Blank and are not used as this scope has been excluded from the Scope of Work.

3. *D5 includes Combustion Parts "CI" Components as Per MARAFIQ's acceptance criteria in the RFP. GE to evaluate Turbine End Components, Buckets, Nozzles and Shrouds for 32K operation and confirm HGP components suitability for 32K extendor.

4. **Amount SAR for line D7 reflects the work scope for 8x new Generators in table 1 or 7 Generator rewinds including D14 Hydrogen Control Panel Scope in table 2.

5. ***Scope Includes Bidder's standard Inspection and Testing activities of installed equipment, along with Performance Test with Station Instrument for Gas Turbine Performance demonstration, considering GT 1-8 will be tested back to back after all applicable scope has been completed on the last GT. Scope will also include Five (5) days Performance Test Training for Two (2) Buyer's Engineers in Greenville, USA or similar location including Facility visit, Training excludes any Travel & Living arrangements by Seller, all expenses to be paid for by Buyer.

6. ****With 8 x new 7A6 Generators 8 new Excitation Systems will be provided, unit 9 will also be upgraded per technical clarifications.

7. HGP spares (Buckets, Shrouds, Power Nozzles) Marafiq will have the stock of 2 sets of capital parts which GE will use during the rehabilitation of first two units. Whatever removed capital parts Marafiq will repair / refurbish and supply to GE for reuse during the rehabilitation of remaining GTG units.

8. All tools and tackles as may be required for the rehabilitation of the GTG units is the responsibility of GE. Spares, consumables, materials (aside from HGP spares mentioned above and consumable as per Major Consumable C-list that shall be related to scope of work) as may be required for the rehabilitation of the GTG units (including rehabilitation of the generator if rewinding option is selected) is included in this cost.

9. Scope for 8x 7A6 Generators include: Main Generator including Generator Stator and Rotor, Generator Coolers, GLAC, GNAC: Line & Neutral Accessory Compartments, Brushless Excitation System, Generator Control Panel, Installation Services with Generator Foundation Modification, Modification of Bus: Generator to GSU Transformer, 6x Generator Breaker – part of GT upgrade, Cooling Water to Gen Coolers (Part of GT upgrade D.1) as required to fit and accommodate the air cooled generator in the existing system for the satisfactory performance of the GTG units for the design life. Any discrepancies arising regarding the amount and nature

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of work, correction to it shall be done by the contractor at no additional cost to Marafig.

10. Training - Only 4 Onsite trainings in Yanbu will be Conducted for 5 Day 5 students for each training class. An additional One (1) Training Class for Performance Testing will be included outside Yanbu Site for duration of 5 days, including 1 day site visit in Greenville Factory for 2 Engineers. All Travel and Livings arrangements Shall be at the cost of Marafiq as GE will not cover Travel and Livings costs and will not provide per-diem.

11. Performance Testing - Section 5

The purpose of the thermal performance test will be to measure the thermal performance after installation of new components per GT basis in simple cycle configuration. The thermal performance test will be in accordance with GEK110972, which is in general agreement with ASME PTC-22 (2005). Work scope for this service is listed in the below outline.

GE Scope includes:

- Test Procedure
- Execution of Performance Test
- Fuel Analysis
- Test Report

Thermal Performance Instrumentation

The measurements to be made with station instrumentation include:

- Compressor Inlet or Ambient Temperature
- Barometric Pressure
- Ambient Relative Humidity
- Inlet Total Pressure
- Inlet Bellmouth Static Pressure
- Compressor Discharge Pressure
- Generator Output Gas turbine generator power output will be measured using station watt-hour meters
- Gas flow static and differential pressures measured on station flow section



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Schedule of Payments

Payment Milestone Events and % payable for Table 1 in Appendix 1
(All Amounts in SR/SAR/Saudi Riyal)

Item C Procurement of materials payments,

15% payment on start of manufacturing upon submission of unconditional bank guarantee and evidence of all material procurement to confirm that contractor is ready in all aspect for start of manufacturing

85% shall be paid upon delivery of materials to Marafig site.

SI. No.	ITEM		% of contract value	Amount - SR
Α	Mobilization and demobilization		5%	29,850,000
	Mobilization		3%	17,910,000
	Demobilization		2%	11,940,000
В	Design & Engineering Services (inclu	uding HAZOP)	5%	29,850,000
	60% Design		1%	5,970,000
	HAZOP		2%	11,940,000
	90% design		1%	5,970,000
	IFC		1%	5,970,000
С	Procurement of materials	35%	208,950,000	
	D.1	Cooling Water Radiator skids	2.00%	11,940,000
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 1	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 2	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 3	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 4	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	MARAFIQ GTG 5	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	CONTRACTS DEPT. GTG 6	0.25%	1,492,500

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Sl. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 7	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 8	0.25%	1,492,500
		GTG 9	0.00%	0
	D.2	Nox Control System -Water Injection	1.5000%	8,955,000
	GE Will issue certification that the Nox Control System -Water Injection is on order and manufacturing commenced	GTG 1	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System -Water Injection is on order and manufacturing commenced	GTG 2	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System -Water Injection is on order and manufacturing commenced	GTG 3	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System -Water Injection is on order and manufacturing commenced	GTG 4	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System -Water Injection is on order and manufacturing commenced	GTG 5	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System -Water Injection is on order and manufacturing commenced	GTG 6	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System -Water Injection is on order and manufacturing commenced	GTG 7	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System -Water Injection is on order and manufacturing commenced	GTG 8	0.1875%	1,119,375
		GTG 9	0.00%	0
	D.3	Speed Tronic from Mark V To Mark VIe upgrades	1.50%	8,955,000
	GE Will issue certification that theSpeed Tronic from Mark V To Mark VIe upgrades is on order add manufacturing commenced	MARAFIQ GTG 1 و MARAFIQ المنافريات والدقوا المنافريات والمنافريات والمنافرات وا	0.1667%	995,000

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SI. No.	ITEM		% of contract value	Amound SR C.A.
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 2	0.1667%	995,000
	GE Will issue certification that theSpeed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 3	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 4	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 5	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 6	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 7	0.1667%	995,000
	GE Will issue certification that theSpeed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 8	0.1667%	995,000
	GE Will issue certification that theSpeed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 9	0.1667%	995,000
	D.4	Compressor Assembly & un- bucketed Turbine Rotors Replacement	9.50%	56,715,000
	GE Will issue certification that the Compressor Assembly & un-bucketed Turbine Rotors Replacements are on order and manufacturing commenced	GTG 1	1.3571%	8,102,142.85
	GE Will issue certification that the Compressor Assembly & un-bucketed Turbine Rotors Replacements are on order and manufacturing commenced	MARAFIQ GTG 2	1.3571%	8,102,142.85
	1	GTG 3	0.0000%	

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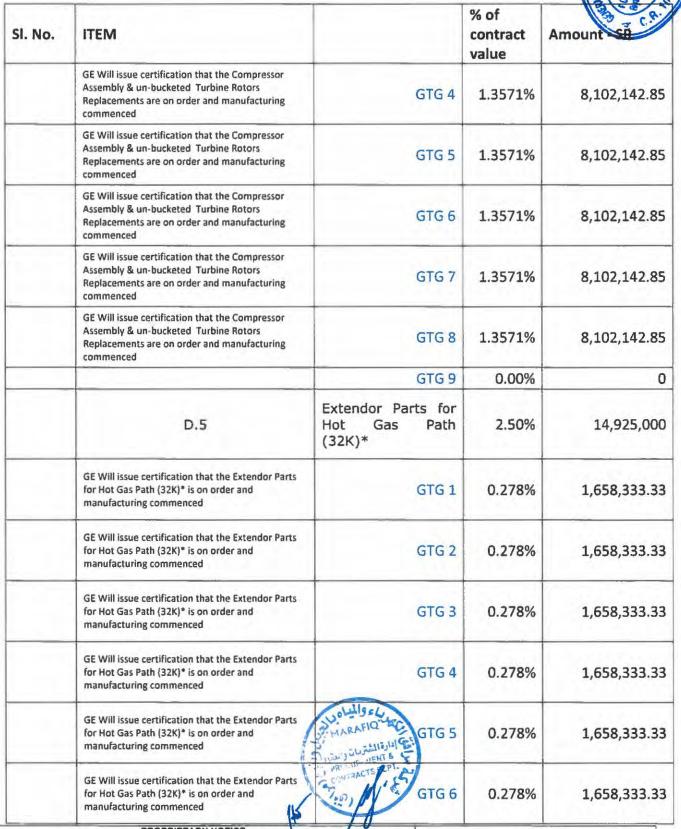
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Sl. No.	ITEM		% of contract value	Amount SR
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 7	0.278%	1,658,333.33
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 8	0.278%	1,658,333.33
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 9	0.278%	1,658,333.33
	D.7	7A6 Generator with Installation and commissioning**	8.00%	47,760,000
	GE Will issue certification that the 7A6 Generator with Installation and commissioning** are on order and manufacturing commenced	GTG 1	1.00%	5,970,000
	GE Will issue certification that the 7A6 Generator with Installation and commissioning** are on order and manufacturing commenced	GTG 2	1.00%	5,970,000
	GE Will issue certification that the 7A6 Generator with Installation and commissioning** are on order and manufacturing commenced	GTG 3	1.00%	5,970,000
	GE Will issue certification that the 7A6 Generator with Installation and commissioning** are on order and manufacturing commenced	GTG 4	1.00%	5,970,000
	GE Will issue certification that the 7A6 Generator with Installation and commissioning ** are on order and manufacturing commenced	GTG 5	1.00%	5,970,000
	GE Will issue certification that the 7A6 Generator with Installation and commissioning ** are on order and manufacturing commenced	GTG 6	1.00%	5,970,000
	GE Will issue certification that the 7A6 Generator with Installation and commissioning** are on order, and manufacturing commenced	MARAFIQ ACC GTG 7	1.00%	5,970,000
	GE Will issue certification that the 7A6 Generator with Installation and commissioning** are on order and manufacturing commenced	PROCEING DEPT. CONTRACT DEPT. GTG 8	1.00%	5,970,000

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Sl. No.	ITEM		% of contract value	Amount R
		GTG 9	0.00%	
	D.8	Replacement of AC/DC Power, Control & Instrumentation Signal Cable	1.00%	5,970,000
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 1	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 2	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 3	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 4	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 5	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 6	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 7	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 8	0.125%	746,250

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0.00%

4.80%

0

28,656,000

GTG 9

Replacement

GTG units

Exhaust Plenum for



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Sl. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 1	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 2	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 3	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 4	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 5	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 6	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 7	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 8	0.60%	3,582,000
		GTG 9	0.00%	0
	D.10	Replacement of GTG Exhaust Shut off and By pass damper Geared motor	0.24%	1,432,800
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 1	0.03%	179,100

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Power and Water Utility Company for Jubail and Yanbu (MARAEIQ)

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SI. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 2	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 3	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 4	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 5	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 6	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 7	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 8	0.03%	179,100
		GTG 9	0.00%	0
	D.11	Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type	0.25%	1,492,500
	GE Will issue certification that the Replacement Generator Transformer & Auxiliary transformer Protection Relay by Digital type are on order and manufacturing commenced	MARAFIQ GTG 1	0.04167%	248,750

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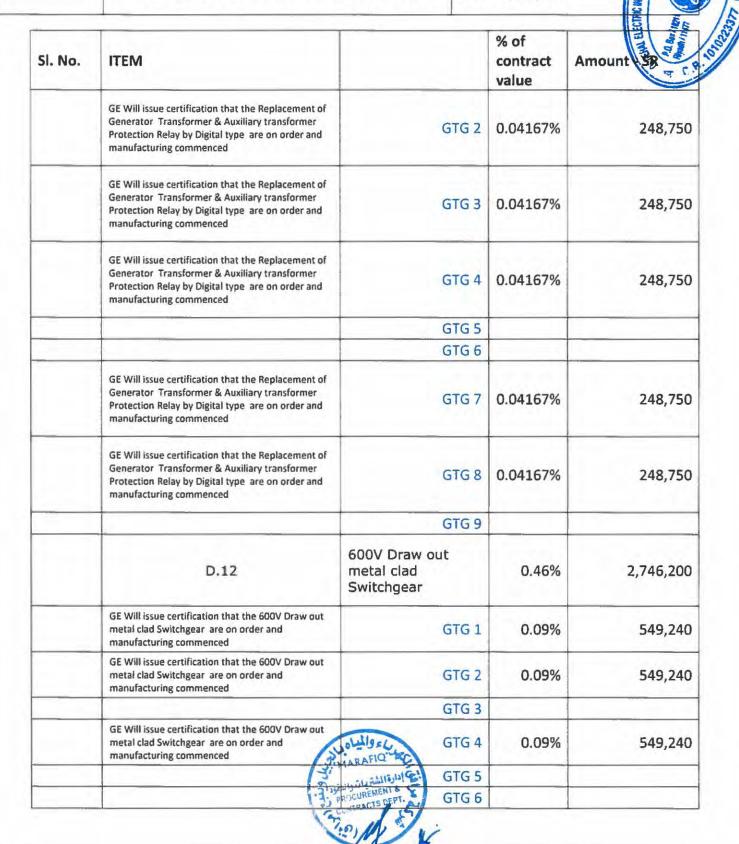
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Sl. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the 600V Draw out metal clad Switchgear are on order and manufacturing commenced	GTG 7	0.09%	549,240
	GE Will issue certification that the 600V Draw out metal clad Switchgear are on order and manufacturing commenced	GTG 8	0.09%	549,240
		GTG 9		
	D.13	Generator Breaker Replacement	1.00%	5,970,000
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 1	0.1667%	995,000
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 2	0.1667%	995,000
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 3	0.1667%	995,000
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 4	0.1667%	995,000
		GTG 5		
		GTG 6		
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 7	0.1667%	995,00
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 8	0.1667%	995,000
		GTG 9		
	D.15	Replacement of AVR by digital Excitation system	0.71%	4,238,70
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 1	0.0789%	470,966.6
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	MARAFIQ MARAFIQ MARAFIQ GTG 2	0.0789%	470,966.6

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SI. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 3	0.0789%	470,966.67
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 4	0.0789%	470,966.67
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 5	0.0789%	470,966.67
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 6	0.0789%	470,966.67
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 7	0.0789%	470,966.67
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 8	0.0789%	470,966.67
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 9	0.0789%	470,966.77
	D.16	Installation of Ventilation fan & hydrogen detectors inside DCC	0.11%	656,700
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 1	0.014%	82,087.50
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 2	0.014%	82,087.50
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	STE MARAFIQ TEC	0.014%	82,087.50
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	PROCUREMENT & CONTRACTS DEPT. GTG 4	0.014%	82,087.50

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Sl. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 5	0.014%	82,087.50
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 6	0.014%	82,087.50
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 7	0.014%	82,087.50
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 8	0.014%	82,087.50
		GTG 9		(4)
	D.17	Motor Control Center Replacement	0.63%	3,761,100
	GE Will issue certification that the Installation of Motor Control Center Replacement are on order and manufacturing commenced	GTG 1	0.090%	537,300
	GE Will issue certification that the Installation of Motor Control Center Replacement are on order and manufacturing commenced	GTG 2	0.090%	537,300
	GE Will issue certification that the Installation of Motor Control Center Replacement are on order and manufacturing commenced	GTG 3	0.090%	537,300
	GE Will issue certification that the Installation of Motor Control Center Replacement are on order and manufacturing commenced	GTG 4	0.090%	537,300
	GE Will issue certification that the Installation of Motor Control Center Replacement are on order and manufacturing commenced	GTG 5	0.090%	537,300
	GE Will issue certification that the Installation of Motor Control Center Replacement are on order and manufacturing commenced	MARAFIQ" GTG 6	0.090%	537,300

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Sl. No.	ITEM		% of contract value	Amount 3R
	GE Will issue certification that the Installation of Motor Control Center Replacement are on order and manufacturing commenced	GTG 7	0.090%	537,300
		GTG 8		
		GTG 9		
	D.18	Gas Flow meter Replacement	0.04%	238,800
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 1	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 2	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 3	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 4	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 5	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 6	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 7	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 8	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 9	0.00444%	26,533.330
	D.19	Replacement of 4.16kV Switch gear	0.68%	4,059,600
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	World of GTG 1	0.09714%	579,942.860

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Sl. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 2	0.09714%	579,942.860
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 3	0.09714%	579,942.860
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 4	0.09714%	579,942.860
		GTG 5		
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 6	0.09714%	579,942.860
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 7	0.09714%	579,942.860
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 8	0.09714%	579,942.860
		GTG 9	, T T	
	D.20	Installation of 2 Nos (GTG) Secondary Unit Auxiliary 4.16kV/0.48kV Dry type transformers	0.08%	477,600
	GE Will issue certification that the Installation of 2 Nos (GTG) Secondary Unit Auxiliary 4.16kV/0.48kV Dry type transformersr are on order and manufacturing commenced	GTG 1	0.04%	238,800
		GTG 2		
		GTG 3		
		GTG 4		اعوالمياهد
		GTG 5		MARAFIQ TO
		GTG 6		אוליניוניוניים פוניבונים פונים פוניבונים פונים פונ
	1	GTG 7	1	CONTRACTS DEPLAT

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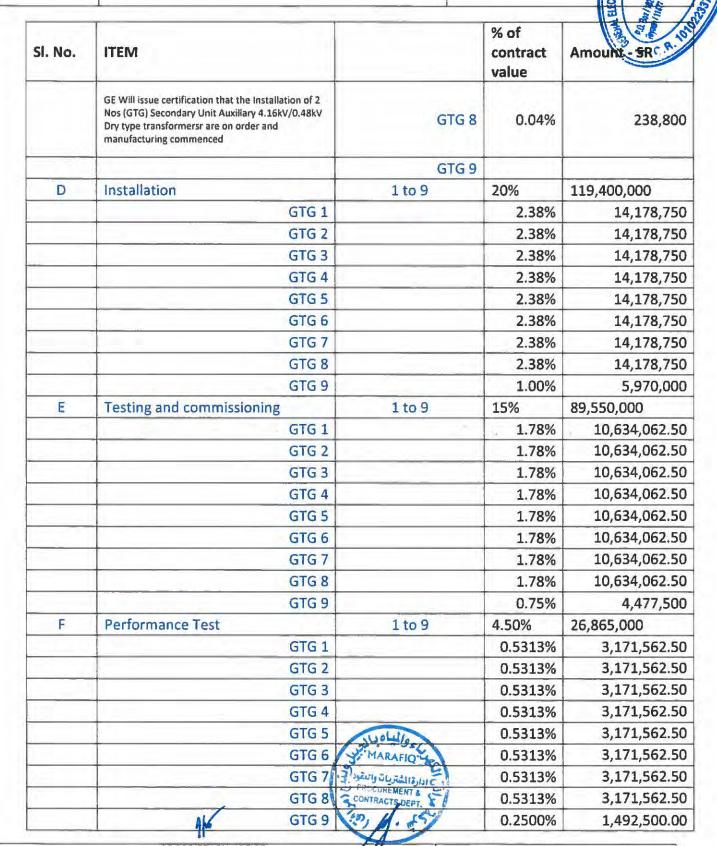
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Sl. No.	ITEM		% of contract value	Amount - SR
G	Reliability test	1 to 9	5%	29,850,000
	GTG 1		0.594%	3,544,687.50
	GTG 2		0.594%	3,544,687.50
	GTG 3		0.594%	3,544,687.50
	GTG 4		0.594%	3,544,687.50
	GTG 5		0.594%	3,544,687.50
	GTG 6	~~	0.594%	3,544,687.50
	GTG 7		0.594%	3,544,687.50
	GTG 8		0.594%	3,544,687.50
	GTG 9		0.250%	1,492,500.00
н	Training (common for all GTG)	common	0.50%	2,985,000
10	Final documentation	1 to 9	10%	59,700,000
35	GTG 1		1.30%	7,761,000
	GTG 2		1.30%	7,761,000
	GTG 3		0.76%	4,519,962
	GTG 4		0.76%	4,519,962
	GTG 5		1.08%	6,430,673
	GTG 6		1.08%	6,430,673
	GTG 7		1.30%	7,761,000
	GTG 8		1.30%	7,761,000
	GTG 9		1.13%	6,754,730





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Payment Milestone Events and % payable for Table 2 in Appendix 1 (All Amounts in SR/SAR/Saudi Riyal)

Item C Procurement of materials payments,

15% payment on start of manufacturing upon submission of unconditional bank guarantee and evidence of all material procurement to confirm that contractor is ready in all aspect for start of manufacturing

85% shall be paid upon delivery of materials to Marafiq site.

SI. No.	ITEM		% of contract value	Amount - SR
Α	Mobilization and demobilization		5%	29,850,000
	Mobilization		3%	17,910,000
	Demobilization		2%	11,940,000
В	Design & Engineering Services (including	(HAZOP)	5%	29,850,000
	60% Design		1%	5,970,000
	HAZOP		2%	11,940,000
	90% design		1%	5,970,000
	IFC		1%	5,970,000
С	Procurement of materials		35%	208,950,000
	D.1	Cooling Water Radiator skids	2.00%	11,940,000
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 1	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 2	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 3	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 4	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 5	0.25%	1,492,500
	GE Will issue certification that the Cooling Water Radiators skids are on order and manufacturing commenced	ARAFIQ GTG 6	0.25%	1,492,500
1	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	OCUREVENTA INTRACTS DEPT. GTG 7	0.25%	1,492,500

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SI. No.	ITEM		% of contract value	Amount SR
	GE Will issue certification that the Cooling Water Radiator skids are on order and manufacturing commenced	GTG 8	0.25%	1,492,500
		GTG 9	0.00%	C
	D.2	Nox Control System -Water Injection	1.5000%	8,955,000
	GE Will issue certification that the Nox Control System - Water Injection is on order and manufacturing commenced	GTG 1	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System - Water Injection is on order and manufacturing commenced	GTG 2	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System - Water Injection is on order and manufacturing commenced	GTG 3	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System - Water Injection is on order and manufacturing commenced	GTG 4	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System - Water Injection is on order and manufacturing commenced	GTG 5	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System - Water Injection is on order and manufacturing commenced	GTG 6	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System - Water Injection is on order and manufacturing commenced	GTG 7	0.1875%	1,119,375
	GE Will issue certification that the Nox Control System - Water Injection is on order and manufacturing commenced	GTG 8	0.1875%	1,119,375
		GTG 9	0.00%	0
	D.3	Speed Tronic from Mark V To Mark VIe upgrades	1.50%	8,955,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 1	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	MARAFIQ AND	0.1667%	995,000

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SI. No.	ITEM		% of contract value	Amount SR
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 3	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 4	0.1667%	995,000
	GE Will issue certification that theSpeed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 5	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 6	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 7	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 8	0.1667%	995,000
	GE Will issue certification that the Speed Tronic from Mark V To Mark VIe upgrades is on order and manufacturing commenced	GTG 9	0.1667%	995,000
	D.4	Compressor Assembly & un- bucketed Turbine Rotors Replacement	9.50%	56,715,000
	GE Will issue certification that the Compressor Assembly & un-bucketed Turbine Rotors Replacements are on order and manufacturing commenced	GTG 1	1.3571%	8,102,142.85
	GE Will issue certification that the Compressor Assembly & un-bucketed Turbine Rotors Replacements are on order and manufacturing commenced	GTG 2	1.3571%	8,102,142.85
		GTG 3	0.0000%	0
	GE Will issue certification that the Compressor Assembly 8 un-bucketed Turbine Rotors Replacements are on order and manufacturing commenced	MARAFIQ MARAFI	1.3571%	8,102,142.85

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SI. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Compressor Assembly & un-bucketed Turbine Rotors Replacements are on order and manufacturing commenced	GTG 5	1.3571%	8,102,142.85
	GE Will issue certification that the Compressor Assembly & un-bucketed Turbine Rotors Replacements are on order and manufacturing commenced	GTG 6	1.3571%	8,102,142.85
	GE Will issue certification that the Compressor Assembly & un-bucketed Turbine Rotors Replacements are on order and manufacturing commenced	GTG 7	1.3571%	8,102,142.85
	GE Will issue certification that the Compressor Assembly & un-bucketed Turbine Rotors Replacements are on order and manufacturing commenced	GTG 8	1.3571%	8,102,142.85
		GTG 9	0.00%	(
	D.5	Extendor Parts for Hot Gas Path (32K)*	2.50%	14,925,000
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 1	0.278%	1,658,333.33
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 2	0.278%	1,658,333.33
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 3	0.278%	1,658,333.33
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 4	0.278%	1,658,333.33
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 5	0.278%	1,658,333.33
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 6	0.278%	1,658,333.33
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	PROCUREMENT & GTG 7	0.278%	1,658,333.33

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SI. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 8	0.278%	1,658,333.33
	GE Will issue certification that the Extendor Parts for Hot Gas Path (32K)* is on order and manufacturing commenced	GTG 9	0.278%	1,658,333.33
	D.7	Generator Rewinds**	8.00%	47,760,000
	GE Will issue certification that material for Generator Rewinds are on order and manufacturing commenced	GTG 1	1.14%	6,822,857.15
	GE Will issue certification that material for Generator Rewinds are on order and manufacturing commenced	GTG 2	1.14%	6,822,857.15
	GE Will issue certification that material for Generator Rewinds are on order and manufacturing commenced	GTG 3	1.14%	6,822,857.15
		GTG 4	1.14%	6,822,857.15
	GE Will issue certification that material for Generator Rewinds are on order and manufacturing commenced	GTG 5	1.14%	6,822,857.15
	GE Will issue certification that material for Generator Rewinds are on order and manufacturing commenced	GTG 6	1.14%	6,822,857.15
	GE Will issue certification that material for Generator Rewinds are on order and manufacturing commenced	GTG 7	1.14%	6,822,857.15
	GE Will issue certification that material for Generator Rewinds are on order and manufacturing commenced	GTG 8	0.00%	
		GTG 9	0.00%	
21.19gm 20.7147	D.8	Replacement of AC/DC Power, Control & Instrumentation Signal Cable	1.00%	5,970,000
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 1	0.125%	746,250

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IMPORTANT



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SI. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 2	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 3	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 4	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 5	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 6	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 7	0.125%	746,250
	GE Will issue certification that the Replacement of AC/DC Power, Control & Instrumentation Signal Cable are on order and manufacturing commenced	GTG 8	0.125%	746,250
		GTG 9	0.00%	0
	D.9	Replacement of Exhaust Plenum for GTG units	4.80%	28,656,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 1	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 2	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 3	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	MARAFIQ إدارة الشتريات والتعر PROCUREMENT & FIG 4	0.60%	3,582,000

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SI. No.	ITEM		% of contract value	Amount SP. R.
Ы	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 5	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 6	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 7	0.60%	3,582,000
	GE Will issue certification that the Replacement of Exhaust Plenum for GTG units are on order and manufacturing commenced	GTG 8	0.60%	3,582,000
		GTG 9	0.00%	(
	D.10	Replacement of GTG Exhaust Shut off and By pass damper Geared motor	0.24%	1,432,800
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 1	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 2	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 3	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 4	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	MARAFIQ GTG 5	0.03%	179,100

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Date: 15 January 2015

SI. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 6	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 7	0.03%	179,100
	GE Will issue certification that the Replacement of GTG Exhaust Shut off and By pass damper Geared motor are on order and manufacturing commenced	GTG 8	0.03%	179,100
		GTG 9	0.00%	0
	D.11	Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type	0.25%	1,492,500
	GE Will issue certification that the Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type are on order and manufacturing commenced	GTG 1	0.04167%	248,750
	GE Will issue certification that the Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type are on order and manufacturing commenced	GTG 2	0.04167%	248,750
	GE Will issue certification that the Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type are on order and manufacturing commenced	GTG 3	0.04167%	248,750
	GE Will issue certification that the Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type are on order and manufacturing commenced	TG 4	0.04167%	248,750
_	TH30EL	STG 5		اء والمناه
		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	3	ARAFIQ TO

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Date: 15 January 2015



SI. No.	ITEM		% of contract value	Amount - 38
	GE Will issue certification that the Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type are on order and manufacturing commenced	GTG 7	0.04167%	248,750
	GE Will issue certification that the Replacement of Generator Transformer & Auxiliary transformer Protection Relay by Digital type are on order and manufacturing commenced	GTG 8	0.04167%	248,750
		GTG 9		
	D.12	600V Draw out metal clad Switchgear	0.46%	2,746,200
	GE Will issue certification that the 600V Draw out metal clad Switchgear are on order and manufacturing commenced	GTG 1	0.09%	549,240
	GE Will issue certification that the 600V Draw out metal clad Switchgear are on order and manufacturing commenced	GTG 2	0.09%	549,240
		GTG 3		
	GE Will issue certification that the 600V Draw out metal clad Switchgear are on order and manufacturing commenced	GTG 4	0.09%	549,240
		GTG 5		
		GTG 6		
	GE Will issue certification that the 600V Draw out metal clad Switchgear are on order and manufacturing commenced	GTG 7	0.09%	549,240
	GE Will issue certification that the 600V Draw out metal clad Switchgear are on order and manufacturing commenced	GTG 8	0.09%	549,240
		GTG 9		
	D.13	Generator Breaker Replacement	1.00%	5,970,000
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 1	0.1667%	995,000
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 2	0.1667%	995,000

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SI. No.	ITEM		% of contract value	Amount
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 3	0.1667%	995,000
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 4	0.1667%	995,000
		GTG 5		
		GTG 6		
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 7	0.1667%	995,000
	GE Will issue certification that the Generator Breaker Replacement are on order and manufacturing commenced	GTG 8	0.1667%	995,000
		GTG 9		
	D.15	Replacement of AVR by digital Excitation system	0.71%	4,238,700
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 1	0.0789%	470,967
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 2	0.0789%	470,967
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 3	0.0789%	470,967
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 4	0.0789%	470,967
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 5	0.0789%	470,967
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 6	0.0789%	470,967
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacting commenced	CU SELIENT & GTG 7	0.0789%	470,967

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SI. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 8	0.0789%	470,967
	GE Will issue certification that the Replacement of AVR by digital Excitation system are on order and manufacturing commenced	GTG 9	0.0789%	470,967
	D.16	Installation of Ventilation fan & hydrogen detectors inside DCC	0.11%	656,700
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 1	0.014%	82,088
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 2	0.014%	82,088
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 3	0.014%	82,088
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 4	0.014%	82,088
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 5	0.014%	82,088
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 6	0.014%	82,088
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	GTG 7	0.014%	82,088
	GE Will issue certification that the Installation of Ventilation fan & hydrogen detectors inside DCC are on order and manufacturing commenced	MARAFIO TO STEE STEEL ST	0.014%	82,088

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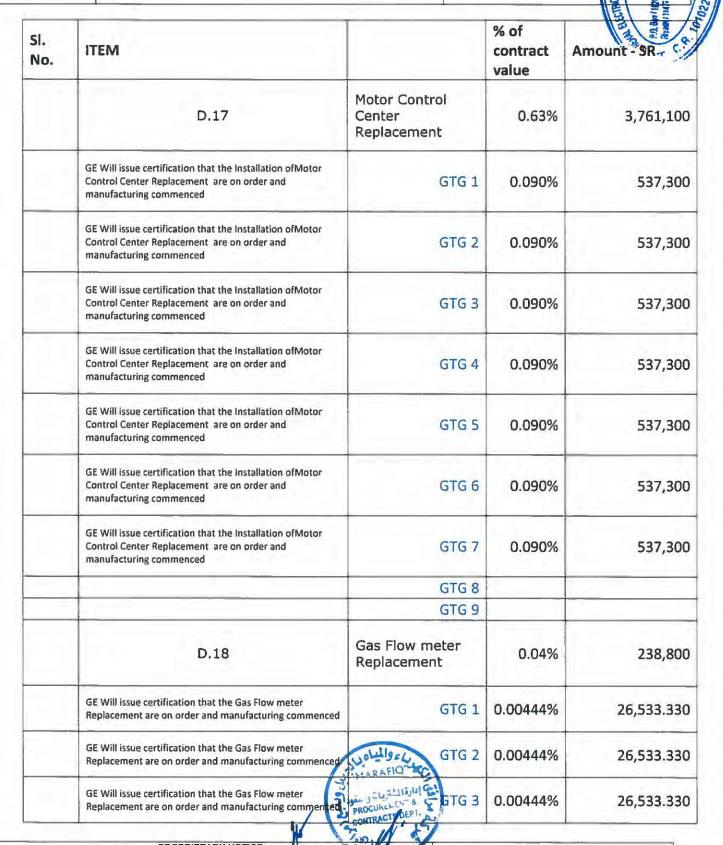
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SI. No.	ITEM		% of contract value	Amount
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 4	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 5	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 6	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 7	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 8	0.00444%	26,533.330
	GE Will issue certification that the Gas Flow meter Replacement are on order and manufacturing commenced	GTG 9	0.00444%	26,533.330
	D.19	Replacement of 4.16kV Switch gear	0.68%	4,059,600
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 1	0.09714%	579,942.860
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 2	0.09714%	579,942.860
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 3	0.09714%	579,942.860
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 4	0.09714%	579,942.860
		GTG 5		
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 6	0.09714%	579,942.860
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commence	MARAFIQ TEC GTG 7	0.09714%	579,942.860

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SI. No.	ITEM		% of contract value	Amount - SR
	GE Will issue certification that the Replacement of 4.16kV Switch gear are on order and manufacturing commenced	GTG 8	0.09714%	579,942.860
		GTG 9		
	D.20	Installation of 2 Nos (GTG) Secondary Unit Auxiliary 4.16kV/0.48kV Dry type transformers	0.08%	477,600
	GE Will issue certification that the Installation of 2 Nos (GTG) Secondary Unit Auxiliary 4.16kV/0.48kV Dry type transformersr are on order and manufacturing commenced	GTG 1	0.04%	238,800
		GTG 2		
		GTG 3		
		GTG 4		
		GTG 5		
		GTG 6		
		GTG 7		
	GE Will issue certification that the Installation of 2 Nos (GTG) Secondary Unit Auxiliary 4.16kV/0.48kV Dry type transformersr are on order and manufacturing commenced	GTG 8	0.04%	238,800
		GTG 9		
D	Installation	1 to 9	20%	119,400,000
	GTG 1		2.38%	14,178,750
	GTG 2		2.38%	14,178,750
	GTG 3		2.38%	14,178,750
	GTG 4	اء والمامد	2.38%	14,178,750
	GTG 5	T. MARAFIQ TO	2.38%	14,178,750
	(P.D. Borri 1921) (1922 A) 1-111 / 4-1-1		2.38%	14,178,750
	GTG 7	PROCUREMENT CONTRACTS DATE	2.38%	14,178,750
	GTG 8		2.38%	14,178,750
	GTG 9	YA	1.00%	5,970,000
E	Testing and commissioning	/1 to 9	15%	89,550,000

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SI. No.	ITEM		% of contract value	Amount - SR
	GTG	1	1.78%	10,634,063
	GTG	2	1.78%	10,634,063
	GTG	3	1.78%	10,634,063
	GTG	4	1.78%	10,634,063
	GTG	5	1.78%	10,634,063
	GTG	6	1.78%	10,634,063
	GTG	7	1.78%	10,634,063
	GTG	8	1.78%	10,634,063
	GTG	9	0.75%	4,477,500
F	Performance Test	1 to 9	4.50%	26,865,000
	GTG		0.5313%	3,171,563
	GTG		0.5313%	3,171,563
	GTG		0.5313%	3,171,563
	GTG	-	0.5313%	3,171,563
	GTG	-	0.5313%	3,171,563
	GTG		0.5313%	3,171,56
	GTG		0.5313%	3,171,563
	GTG		0.5313%	3,171,563
	GTG		0.2500%	1,492,500
G	Reliability test	1 to 9	5%	29,850,000
	GTG		0.594%	3,544,688
	GTG		0.594%	3,544,688
			0.594%	3,544,688
	GTG GTG GTG GTG GTG		0.594%	3,544,688
	GTG		0.594%	3,544,688
	A (Piped 1987) (G) HW/ July 1 GTG	_	0.594%	3,544,688
			0.594%	3,544,688
	GTG GTG GTG		0.594%	3,544,688
	GTG		0.250%	1,492,500
Н	Training (common for all GTG)	common	0.50%	2,985,000
1	Final documentation	1 to 9	10%	59,700,000
	GTG	المعرفة المعرف	1.30%	7,761,00
	GTG	A A MAKAPIO AC	1.30%	7,761,00
	₩ GTG	PROCUREMENT &	0.76%	4,519,96



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SI. No.	ITEM	% of contract value	Amount - SR
	GTG 4	0.76%	4,519,962
	GTG 5	1.08%	6,430,673
	GTG 6	1.08%	6,430,673
	GTG 7	1.30%	7,761,000
	GTG 8	1.30%	7,761,000
	GTG 9	1.13%	6,754,730





Gas Turbine Generators
Rehabilitation by Replacement of
Major Parts - YANBU

Contract PO # 720 002 6909 (Volume 3 of 3) Attachment D

Attachment E

General Electric International Inc. (GEII)

POWER & WATER UTILITY COMPANY FOR JUBAIL AND YANBU (MARAFIQ) YANBU



Attachment D

Scope of Works

Contract PO No. 7200026909

Gas Turbine Generators Rehabilitation by Replacement the Major Parts Scope of Work







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SECTION – I INFORMATION TO BIDDERS







1 Introduction

Power, Desalination and Seawater Cooling (PD&SC) facilities complex of MARAFIQ referred herein after as MARAFIQ Yanbu, located in Madinat Yanbu Al-Saniyah, own and operate MYAS Power, Desalination and Seawater Cooling Facilities that generate, transmit and distribute water & electricity to industries and communities in Madinat Yanbu Al-Saniyah refer herein after as MYAS. Marafiq Power and Water Plant were constructed in 1980's with various supporting plants and utilities.

MARAFIQ is operating Eight Frame 7001E Gas Turbines since 1982. These were supplied by Hitachi_(licenced by GE). Gas Turbine Plant is Cogeneration Power Plant consists from nine (9) Gas Turbine Generators. GTG # 1 – 8 are frame 7001E of 56.17 MW. GTG # 9 is frame 7001EA of 68.82 MW. The primary fuel is Sales Gas and the secondary fuel is light fuel oil (LFO). The Gas Turbines are Connected with five (5) Heat recovery Steam Generators. Two gas turbines (GTG1 TO 8) are connected to one HRSG unit; however, only one turbine exhaust can be fed to the unit, while the other turbine is either operating in its simple cycle mode or combined Cycle. The exhaust gases from one turbine will either pass through an open guillotine damper to the associated HRSG, or to be exhausted to atmosphere through a gas turbine by-pass stack controlled by modulating damper, with the guillotine damper fully open and the stack damper fully open. While the ninth GTG unit # 9 is coupled to HRSG 5 only.

2 Project Objective

MARAFIQ intends to go for GTG frame 7001E rehabilitation by replacing the Major Parts, since all Gas Turbine Generator's rotors have reached to 200K and following Major Items need to be replaced: -

- A. Replacement of Cooling Water Radiator Skids for GTG Units 1 8
- B. Installation of NOX Control System for GTG Units 1 8.
- C. Upgrades of Speed Tronic from Mark V to Mark Vie for GTG Units 1 9.
- D. Replacement of Compressor Assembly & Un-bucketed Turbine Rotors of GTG # 1 8 except GTG No.3.
- E. Extendor Parts of GTG# 1-8
- F. Full unit uprates of GTG# 1-8 except GTG No.3
- Rewinding of Generators for GTG Units 1 7.
- H. Replacement of AC/DC Power, Control & Instrumentation Signal Cable for GTG Units 1 8.
- Replacement of exhaust plenum for GTG units 1-8.
- Replacement of shut off & By pass damper geared motor for GTG units 1-8.
- K. Replacement of Protection Relay by Digital Type of GTG unit 1, 2, 3, 4, 7 & 8.
- L. Replacement 600 V Draw out Metal Clad Switchgear for GTG 1,2,4,7 & 8.
- M. Replacement Generator Breaker of GTG unit 1, 2, 3, 4, 7 & 8.
- N. Replacement of Hydrogen Control Panel for 3 8.
- Replacement of AVR by Digital Excitation System for GTG Units 1,2,3,5,7 & 8.
- P. Installation of HVAC System and Hydrogen Detectors inside DC Compartment for GTG Unit 1 8
- Q. Replacement of MCC for GTGs 1-7.
- R. Replacement of Gas Flow meter & other Field instruments for GTG Unit-1 to 9
- Replacement of 4.16 kV Switchgear for GTGs # 1,2,3,4,6,7 & 8
- T. Supply of 2 Nos (GTG) Secondary Unit Auxiliary 4.16kV/0.48kV Dry type transformers (To be kept as spares)
- U. GTG Performance Test and Training.
- V. Training to MARAFIQ Staff





The above Item B. Installation of Water Injection System for GTG Units 1-8. And C. Installation of DLN-1 System for GTG Units 1-8. Bidder is requested to select any one of the best available technology to suit our Existing condition of the system to augmentation of the Power production, Control the NOX level less than 80 PPM varies load condition and exhaust temperature should not reach not more than 590 °C and Elimination of Combustion inspection.

3 Project location

This project is related to the MARAFIQ facilities complex in the Industrial City of Yanbu which is located at latitude of 240 00'N, and longitude of 380 10'E. It is relatively flat, rising 10m from the shoreline to the regional highway, which is the northeast boundary of the City development. The works of the project shall be located within the complex.

4 Site Conditions

- A. The MYASPP is located at an elevation less than 1000 meters above sea level in a seismic zone classification defined in Madinat Yanbu Al Sinaiyah (MYAS) Building Code.
- B. Climatic Conditions-Air Temperatures

Range of monthly maximum	35.1 to 60.0 C
Range of monthly minimum	6.0 to 12.00 C
Range of monthly mean daily maximum	25.5 to 35.90 C
Range of monthly mean daily minimum	12.3 to 26.00

C. Relative Humidity

Maximum relative humidity	100%
Maximum relative humidity	6%

D. General data from available records:

Annual Rainfall (erratic)	Average of 100 mm
Wettest Months	December through March
Driest Months	April through November
Wind Velocity	Maximum of 135 km/hr
Velocity and Exposure	Class C (carrying sand and dust)
Seismic Classification	Zone 2A
Longitude	38.2275 ° E
Latitude	23.9994 ° N

E. Site Data, for GTG units

Altitude	: Sea Level
Shaft Rotational speed	: 3,600 rpm
Lubricating Oil Reservoir Capacity	: 11,000 L
Fuel	: Sales gas/Distillate Oil.
Starting Means	: 670 kW electric motor
Intake Air Design Flow	: 822000 m ³ /Hr





Exhaust Gas Outlet Temp Exhaust Gas Outlet Press AIH Filter min/max Press drop Cooling water flow : 400 ~ 500 C9 : 305 mmwg : 55/65 mmwg : 394411 kg/hr

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F. Loading Time

Normal 20 minutes / Fast Load 9.5 minutes

G. Rated Load, Sales Gas at site (50 C)

Simple-cycle Combined- Cycle Base 56, 570 kW 55, 720 kW / Peak 62, 310 kW 61, 370 kW

H. Climatic condition - GTG performance:

During the summer month, the temperature varies from 45° C to 60° C and it has been observed that the radiator skid cooling water temperature difference between inlet and outlet is 1° C or less, thus reducing radiator skid performance, thus requiring the use of external cooling arrangement thru water spray involving extra manpower and loss of water resources.

Cooling water temp_{in} to the radiator heat exchanger = 60 °C Cooling water temp_{out} from the radiator heat exchanger = 59 °C

5 Scope of Services

The Contractor's scope of services shall include the following as a minimum.

The scope of services for each task includes complete field survey and verification of existing utility system interfaces, engineering and design services, manufacturing, procurement, coordination/interface with other contractors, construction and testing as well as the provision of associated drainage, erosion control, detours and all pertinent items as described below, and as necessary to complete the work satisfactorily.

The bidder shall take dismantled Part from Rehabilitation and Available Capital Spares from Marafiq Ware house in the Parts Exchange Programme (Whichever applicable).

The Contractor shall provide onsite personnel as required throughout the design period to obtain the necessary information. Contractor shall provide on-site personnel, as required, to retrieve information from as-built drawings and other documents at the MARAFIQ Library, required for preparation of designs, drawings and specifications for the work under this Contract. On-site personnel shall include a minimum of one engineer with experience of GTG plants from initiation of design through the intermediate design submittal and review. In addition, the Contractor shall assign an on-site coordinator during the entire design phase.

The preparation and submission of design, construction and shop drawings, specifications, system analysis, studies, calculations, DCS documents, product data and samples pertaining to all engineering disciplines, for review and approval by MARAFIQ. Process system studies and analyses must be performed and presented to MARAFIQ before design drawings are finalized or equipment is purchased. Refer to detailed sow for additional study/analysis requirements for each item. All design drawings, except existing drawings requiring revisions, shall be prepared by the Contractor using Bentley Microstation drafting methods. Refer to Technical Requirements and Section 01720 Record Documents.



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The preparation and submission of cutover plans and work-around plans for activities that require interface with energized and operational systems and equipment.

The provision of all purchasing, expediting, inspecting, delivering, handling and interim storage of materials and equipment required for the work.

The provision of all materials, equipment, supervision and labor necessary to complete the work in accordance with the approved design and specifications.

The Contractor's services and performance shall be such as to complete all work in an efficient and timely manner. The Contractor shall submit a complete and organized drawing and document submittal schedule at the start of design work for MARAFIQ review and approval.

Implementation of manufacturer's standard and otherwise specified quality control, inspection and product testing programs.

Preparation of commissioning and start-up procedures.

The development of test criteria and preparation of both factory and site test plans and procedures for submission to MARAFIQ for approval.

Preparation of reports on performance, field and factory tests.

Preparation of operation and maintenance manuals, DCS and Mark-VIe documents.

Preparation of As-Built drawings including revision of existing original As-Build's to reflect changes occasioned by this contract. Contractor shall use, if available, MARAFIQ furnished originals of existing as-built drawings for this purpose. The revised as-built drawings shall match the existing format. The Contractor shall provide as-built drawings in accordance with Section 01720, Record Documents.

Preparation of a Recommended Spare Parts List (RSPL) for normal operation of all equipment and buildings and procurement of approved spare parts, as cost reimbursable items.





SECTION – II GENERAL REQUIREMENTS





1- Site Survey

The contractor shall examine the site for investigation and satisfy himself, with the nature of work and setting of site where the contract shall be performed.

It is deemed that the contractor has understood the nature of work prior to submitting of proposal, any discrepancies arising regarding the amount and nature of work, correction to it shall be done by the contractor at no additional cost to the owner.

2- Contractor's Responsibilities

- A. It is deemed necessary that contractor has obtained all the required information and data, which are required for effective and timely completion of work in highly professional and qualitative manner.
- B. The Contractor shall be obliged to perform the work with full safety, security and in a timely manner.
- C. The work shall comply with applicable Marafiq Specifications and Standards, RC Design Criteria / Guideline Specifications, Industry Codes/standards and shall be based on good engineering practices.
- D. Engineering work shall include but not be limited to Detailed Design of the Work.
- E. Procurement work shall include identification of required materials and equipment, Preparation of Material Take-offs and Purchasing Specifications, PO Placement, Expediting, Material inspection, Delivery of material to site, etc.
- F. Construction shall consist of mobilization, site preparation, installation of equipment, electrical and instrumentation works, electrical grounding, all other works required for complete and satisfactory operation. Furthermore, the works shall be tested and commissioned prior to Contractor's demobilization.
- G. In accordance with Marafiq procedures, the Contractor has to obtain Marafiq's concurrence for the prequalification of major material suppliers/vendors & sub-contractors for design and construction.
- H. All components and accessories shall be supplied by the Contractor and shall be based on Industry standard applied to tropical country and to area in proximity to seashore ambient conditions of 55°C maximum temperature and 5-100% relative humidity.
- I. This scope of work describes all the work and work related activities to be carried out by the Contractor. Any specific work or activity inadvertently not included in the scope of work but deemed to be necessary for the successful operation of the installation as intended by this document shall be considered as included in the scope of work of the Contractor.
- All design and shop drawings, calculations and such other documents once approved by Marafiq shall not be revised or modified without written prior approval from MARAFIQ.
- K. It shall be the Contractor's responsibility to select and supply all materials and equipment that have been designed/fabricated for the required service conditions in accordance with all the applicable codes and standards, and the current standards of engineering and workmanship suitable for the intended purpose.
- All equipment and shall be designed for not less than 30-years of service life under normal operating conditions with specified maintenance.
- M. The Contractor shall recommend two year spares requirement for the full scope of work and shall provide for Marafiq's review the recommended spare parts list from manufacturers and suppliers. Purchasing of recommended spare parts shall be done directly by Marafiq or by the Contractor against actual costs plus an agreed upon administration fees in accordance with GC-38, Attachment A.
- N. Start-up & commissioning spares shall be supplied by the Contractor.
- MARAFIQ safety procedures shall be followed during the construction and commissioning period of the project.
- P. The Contractor shall submit the design drawings/documents and materials/equipment purchase requisitions formally to Marafiq for review and approval. The procurement shall be carried out only after approval from Marafiq.
- Q. Contractor shall arrange for power, water, and worker facilities, etc. for their site office, and for Construction and testing purposes.
- R. For site office utilities connections, on contracts general conditions GC.17 as well as Mobilization clause requirements, says that contractor is responsible to provide all requirements of utilities connection to his site of the down area. In case of contractor needs Marafiq to supply him "subject for availability",

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- Cost for providing the temporary utilities shall be borne by the Contractor. Utilities such as electricity and water provided by MARAFIQ shall be on payment basis at the prevailing rates.
- Contractor obliged to obtain Access Permit Request / Permit to work, duly approved/coordinated by MARAFIQ Operation, Maintenance and Safety prior to commencing any fieldwork. The contractor is required to submit the application for permits well in advance.
- T. Contractor shall execute the work continuously and provide qualified personnel and other appropriate work force. The contractor shall supervise directly and control completely his employees at any time during execution of work, including supervision, material, methods, techniques, procedures subject to compliance with contract requirements and applicable standards, laws, rules and regulations.
- U. Contractor shall perform and complete the work in accordance with the contract and to the satisfaction of MARAFIQ and shall comply and adhere to his/their instructions and directions.
- V. Contractor shall submit equipment catalog and shop drawings, project drawings, connection diagrams and other submittals in accordance with the requirements of the applicable standards and subject to MARAFIQ approval prior to the procurement of any equipment and materials.
- W. Contractor shall submit the project completion schedule for review and approval by MARAFIQ. The detailed work schedule establish the definitive plans for execution of various activities and achieving of critical milestones.
- X. Contractor shall provide a written guarantee covering the materials and workmanship against the latent defects and other physical damages due to the normal wear and tear for a period of one year from the date of acceptance of the work by MARAFIQ.
- Y. Contractor shall be responsible that all project drawings, construction materials, equipments, installation and workmanship provided under this contract comply with the contract provisions. Revision or submittals approval by MARAFIQ does not release the contractor from his obligation regarding equipment performance in accordance with applicable codes and standards and specifications.

3- Project Procedures

The contractor shall prior to start of work on the project, prepare and submit project procedures package regarding; communication between all Parties, schedule of activities, project documentation, record keeping, safety and security requirements, subject for MARAFIQ approval.

4- Contract Schedule

- A. Contractor shall submit to MARAFIQ, a detailed project schedule showing the activities and sequence of operations needed for the orderly performance and completion of the work.
- B. Contractor shall prepare and submit for MARAFIQ approval a cutover plan prior to commencement of modification work. The purpose of this plan is to ensure that during the cut-over there is no unscheduled power outage to any of the equipment. The plan shall be in narrative form, describing the work sequence and the method the implementing of entire activities with minimum services downtime.
- C. Contractor shall GTG Rehabilitation work to be executed as per Marafiq maintenance plan schedule. The Contractor shall provide detailed Level-III schedule for executing all the works for each GTG in technical proposal.

5- Safety requirements

A. The contractor and its subcontractors performing work at the site shall be required to comply with and enforce strictly all the required MARAFIQ Industrial Safety rules, regulations and practices.





B. The contractor shall coordinate with MARAFIQ Industrial Safety section. The contractor shall have deemed to understand all the safety requirements related with the work and is responsible to act upon accordingly.

6- Contractor's authorized representatives

The contractor shall designate a key person as Contractor Authorized Representative to act for and to commit in its behalf regarding all matters under the contract. Any orders, notices, or instructions which owner may give to the said Authorized Contractor Representative shall be deemed to have been given to the contractor.

7- Submittals point of delivery

Contractor shall deliver miscellaneous submittals for review and approval by MARAFIQ designated representative.

8- Commencement and completion of work

- A. Contractor shall commence performance of work upon the date specified in the formal notice to proceed issued by MARAFIQ to contractor and shall furnish sufficient personnel, materials, tools and equipment. The contractor shall prepare and submit the schedule for MARAFIQ approval.
- B. The contractor shall observe and exercise professionalism, care and diligence in performing the work in a manner acceptable to the industry.
- C. Contractor should perform the job within Three year total for Gas Turbine 1 to 8.

9- Security

- a) During the performance of the work, the contractor shall be responsible for internal security and protection of all his equipment, materials and tools, etc. The contractor shall at his own expenses provide boxes and / or store for all portable tools, equipment and material required or used in the work.
- b) The contractor shall request and obtain the required security / MARAFIQ access badges from the MARAFIQ Security prior to site mobilization. Such request shall be made in sufficiently in advance to allow the approval and preparation of security badges on time.

10- Performance Test and Acceptance

The contractor shall be responsible to carry out performance test for all units after completion of commissioning as per the latest revision of performance test Procedure

ASME (PTC#22). MARAFIQ will, following delivery of the request by the contractor, witness all required tests and either indicate its acceptance or notify the contractor about the deficiencies which are discovered and are required to be completed by the contractor within mutually agreed time limit. Upon completion of specified deficiencies, MARAFIQ shall either accept or give contractor notice of failure to complete the work or correct the specified deficiencies. Contractor will submit performance curves & calculations to assess the output & Heat rate according to contractual agreement.

11- Cleaning and Removal

The Contractor shall, at all times, keep the work site areas, under its use, in a neat, clean, and safe condition and shall dispose of all rubbish and other unwanted materials. Contractor shall also ensure that the entire project related labor and material employed by contractor are removed from the work site upon completion of the work.







12- Additions and Deletions

- MARAFIQ shall have the right to revise scope of the work items either by increasing the value of work or by reducing the number of scope items. In such cases the contract shall be amended accordingly.
- No change shall be made by the contractor without an order in writing of MARAFIQ.
- All extra or additional work done, work omitted by order of MARAFIQ shall be valued at the rates and prices set out in the contract.

13- Protection of Existing Facilities

The contractor shall be responsible for protection of the existing installations and preventing any loss caused by personnel or equipment movement while working at site. The contractor shall take every positive action to protect the existing facilities from any damage resulting during implementation of this project. Unless otherwise specifically directed the contractor shall protect all existing facilities from any loss and prevent interruption of the services. The contractor shall be fully responsible for any damage to the existing installations during the execution of work. Any loss, if occurred, shall be repaired and/or replaced, to restore to the original condition, at no additional cost to the owner.

14- Work Performance/Contractor's Responsibilities

- A. It is deemed necessary that contractor has obtained all the required information and data, which are required for effective and timely completion of work in highly professional and qualitative manner.
- B. The contractor shall be obliged to perform the work with full safety, security and in a timely manner.
- C. The contractor shall be required to obtain Access Permit Request / Permit to work, duly approved/coordinated by MARAFIQ Operation, Maintenance and Safety prior to commencing any fieldwork. The contractor is required to submit the application for permits well in advance.
- D. The contractor shall execute the work continuously and provide qualified personnel and other appropriate work force. The contractor shall supervise directly and control completely his employees at any time during execution of work, including supervision, material, methods, techniques, procedures subject to compliance with contract requirements and applicable standards, laws, rules and regulations.
- E. The contractor shall perform and complete the work in strict accordance with the contract, and to the entire satisfaction of the designated MARAFIQ representative and shall comply and adhere to his/their instructions and directions.
- F. The Contractor Shall Perform Units are dismantled and removed and transported to a designated disposal area approved by Marafiq.

15- Quantities

The contractor shall prepare and submit a detailed Bill of Quantities, for MARAFIQ approval, against the work to be executed under this contract, based on the scope of work document and actual site requirements. The quantities provided are for reference only.







SECTION – III TECHNICAL REQUIREMENTS





1 Contract documents

A number of documents forming this contract (i.e. Contract Basic Form, Scope of Work, technical Specification, General Terms and Provisions, , and drawings etc.) are correlative, complementary and mutually explanatory, and any work required in one document and not mentioned in another shall be performed to same extent and purpose as though required by all.

2 General scope of services

The work that to be performed under this contract consists of furnishing all labor, supervision, tools, equipment, technical and professional services, materials supplies and articles necessary to perform work involving "detailed engineering design, supply, procurement, installation, performance testing and commissioning for replacement of major parts of frame 7E GTG units # 1 to 8 on and conducting performance test on both fuels (Sales Gas and LFO)".

3 Protection of existing facilities

The contractor shall be fully responsible for the damage of any existing facilities during the execution of work any damages, if occurred, shall be built by repairing and/or replacing, to restore to the original conditions, at no additional cost to the MARAFIQ.

4 Mobilization and demobilization

- a) The contractor shall arrange and provide at its own expenses for all mobilization and demobilization of its equipment and personnel, including, but not limited to, temporary facilities and transportation.
- b) Demobilization includes all work related to moving out, upon satisfactory completion of work and shall include removal of equipment, tools, supplies and personnel and disposing of excess materials. It also includes the final submittals of As-Built drawings.

5 Assignment of contract, subcontract and purchase order

The contractor shall be authorized to subcontract a portion of the work to others but shall not subcontract the whole of the work. The contractor shall not subcontract any part of the work without prior written consent of MARAFIQ, and such consent, if given, shall not relieve the contractor from any liability and obligation under the contract.

6 Supply and Procurement

The contractor shall be responsible for the supply and delivery to site of all equipment, materials and supplies require for accomplishing and performing the work.

7 Schedule & Progress Report

7.1. SCHEDULE

The Contractor shall prepare all Schedules using Primavera or Microsoft Project software. The original file format shall be sent to MARAFIQ in an unlocked format. All planning and scheduling requirements shall be prepared for the approval of MARAFIQ, both to content and as to format.

Within fourteen (14) days of the Commencement Date, the Contractor shall prepare and submit for approval a ninety (90) day look ahead early Work Schedule for all activities. This shall be kept updated and reissued to 11/2







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MARAFIQ on a weekly basis until a detailed network based Schedule has been developed, agreed with MARAFIQ, and issued for implementation.

The Contractor shall within fourteen (14) days of the Commencement Date, prepare and re-issue to MARAFIQ for approval an Overall Project Summary (Level 1) Schedule that provides for completion of the Works within the Time for Completion and completion of the Milestones by the Milestone Dates. The Schedule shall not be amended without MARAFIQ's prior agreement, which it is anticipated shall only be where it can be demonstrated to MARAFIQ's satisfaction that significant changes to work scope have taken place that directly impact critical path activities and which cannot be mitigated by other actions.

Within thirty (30) days after the Commencement Date the Contractor shall prepare and submit to MARAFIQ for approval a comprehensive Schedule of Deliverables listing all documents and other deliverables to be submitted for the entire duration of the Works. Such deliverables shall include, but not be limited to: method statements, vendor documents, data sheets, process flow diagrams (PFDs), piping and instrumentation diagrams (P&IDs), general arrangement drawings (Gas), HSE Plan, Quality Plan, Project Execution Strategy, Construction Execution Strategy and other similar submissions. The Contractor shall update and resubmit the Schedule of Deliverables whenever necessary to reflect the development of his design.

Within ninety (90) days of the Commencement Date, the Contractor shall submit to MARAFIQ for approval a detailed CPM Logic Network Level 3 Schedule that shall define the Project Management, Engineering, and Procurement Activities. It shall also define (at Level 2 detail) all Construction, Completion, Commissioning and other activities through to Initial Acceptance by MARAFIQ. The Schedule shall define but not be limited to the following:

Interfaces with other contractors
Milestone Dates
Latest dates for document issues for the Contractor to meet the Schedule
Significant design/engineering submission and review dates
Delivery dates for Plant and Equipment
Manning levels showing supervision and trade mix

The Contractor shall update and reissue the Level 3 Schedule to MARAFIQ on a monthly basis. More frequent updating will be required if based on the critical path of events the scheduled Time for Completion and/or Milestone Dates is in danger of being compromised.

The Contractor shall meet monthly with MARAFIQ to review progress against the Level 3 Schedule and to present proposals where necessary to recover Schedule slippages, including proposals for specific detailed workarounds to prevent/recover slippages to events close to or on a critical path.

The Contractor shall also extract from the Level 3 Schedule and issue monthly to MARAFIQ a look ahead Schedule covering the upcoming 3 month period.

The Contractor shall also issue monthly to MARAFIQ a summarized Level 2 Schedule, also extracted from the Level 3 Schedule, front lined to indicate achieved progress, any slippages and forecast event completion dates where slippages have occurred or are anticipated to occur.

Contractor shall prosecute the Works in accordance with the Schedule. Reasonable variation in the sequence of activities shown on the Schedule is permissible, provided that:

Such variation does not jeopardize timely completion of the Works, Milestone Dates or Sections of the Works having separate completion dates,

No interference to the operation of Other Contractors is caused thereby, and:

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Such variation shall be subject to prior consent of MARAFIQ. Contractor shall at all times notify MARAFIQ of any such proposed variation and of its daily schedule of operations.

The Contractor shall allow for rescheduling the Works as necessary in a flexible manner to accord with the interfacing requirements of the Contract. No claims for additional reimbursement shall be entertained in regard to the flexibility requirement of the Contract.

The Contractor shall provide a manpower forecast by discipline and craft. The forecast shall be in histogram form and shall include all labor below the level of non-working foremen and shall be divided into the applicable trades and into skilled, semi-skilled, unskilled, etc. classifications as appropriate and shall separately identify Subcontractors' labor.

7.2. PERMITTING SCHEDULE

Within ninety (90) days of the Commencement Date, the Contractor shall submit to MARAFIQ for approval a separate Permitting Summary Schedule detailing all activities including but not limited to permit preparation, submittal and approval cycle and the start and finish dates for the progress of these activities. Each permit must be clearly identified as separate line items within the Permitting Summary Schedule.

The Contractor shall also produce and issue to MARAFIQ a detailed permitting activity schedule at individual permit level. This shall be maintained up to date by Contractor and issued to MARAFIQ on a monthly basis.

7.3. CONTRACTOR'S CONSTRUCTION SCHEDULE

When design definition has been sufficiently established during detailed engineering, and in any case no later than four (4) weeks prior to the commencement of work on site, Contractor shall produce and issue to MARAFIQ a detailed CPM Logic Network (Level 3) Construction Schedule ensuring that all criteria relating to the execution of the Works have been met. Failure to include any works item required for performance of the Contract shall not excuse Contractor from completing all Works within the applicable Time for Completion regardless of MARAFIQ's acceptance of the Schedule.

This Schedule shall be structured to accurately reflect the agreed Work Breakdown Structure and any further work break down between the planned scope of each fabrication and construction Subcontractor. It shall include for all agreed milestone events and be fully resource loaded for fabrication and construction activities. It shall include for milestone events reflecting Contractor's planned move from area / trade based construction progressing to systems based construction completion.

This Schedule shall, in addition to construction events, also include for all System completion, commissioning, start-up and Performance Testing events through to the offering and acceptance of operational systems by MARAFIQ. The development of this Schedule will have required Contractor firstly to identify all Systems making up the overall scope of work, their approximate size and complexity, and the planning of the sequence in which they must be brought to completion to support commissioning pre-requisites.

The Schedule shall allow realistic durations for System completion activities including site inspection walk downs by Contractor and MARAFIQ, and clearance of Punch List items.

Contractor shall meet twice monthly with MARAFIQ at Site during construction to review progress against the Level 3 Schedule and to present proposals where necessary to recover schedule slippages, including proposals for specific detailed workarounds to prevent/recover slippages to events close to or on a critical path.







Contractor shall update and reissue the Level 3 Schedule to MARAFIQ on a monthly basis. More frequent updating will be required if based on the critical path of events the scheduled Time for Completion and/or Milestone Dates is in danger of being compromised.

Contractor shall also extract from the Level 3 Network and issue monthly to MARAFIQ a look ahead schedule covering the upcoming 3 month period.

Contractor shall also issue monthly to MARAFIQ a summarized Level 2 Schedule, also extracted from the Level 3 Network, front lined to indicate achieved progress, any slippages and forecast event completion dates where slippages have occurred or are anticipated to occur.

7.4. SYSTEMS COMPLETION SCHEDULE

The Contractor shall further plan its system completion and commissioning activities and prepare and issue to MARAFIQ a detailed Systems Completion Schedule no later than 30% achieved construction progress at Site.

This schedule shall, at an individual system level, schedule all activities associated with the bringing of systems to completion for inspection walk downs, Punch List clearance, testing, commissioning and performance demonstration testing through to offering to MARAFIQ for takeover. This shall include for the completion of System QC Dossiers (construction and commissioning) and red-lined as-built documents.

This schedule shall be updated and reviewed with MARAFIQ on a monthly basis.

7.5. RECOVERY PLANNING

If at any time MARAFIQ is of the opinion that the progress of the Works is delayed such that the Works are unlikely to be completed by the Time for Completion or that a Milestone Date will not be complied with (after taking account of any extension of time granted under Special Condition SC-2 "Commencement and Completion") MARAFIQ shall be entitled to require Contractor to submit within 14 days a revised Schedule demonstrating Contractor intends to reorganize the Works in order that completion within the Time for Completion and/or compliance with Milestone Dates can be achieved (the "Recovery Plan").

In any case if the progress update indicates the Works is fourteen (14) or more calendar days behind the current Schedule, Contractor shall submit a Recovery Plan indicating means by which Contractor intends to regain compliance with the Schedule.

All remaining activities shall be re-scheduled based on the remaining duration for each activity. Remaining duration values must be realistic and reflect the previous recorded progress. The Recovery Plan shall include a revised manpower histogram showing realistic personnel resource levels in line with the remaining duration. Under no circumstances shall the Recovery Plan indicate a revised Time for Completion or Milestone Dates without prior approval and agreement from MARAFIQ.

The revised baseline Schedule along with the proposed Recovery Plan, critical path analysis, manpower deployment histogram (Revised & Original) and other planning reports shall be submitted to MARAFIQ for approval. Contractor shall ensure that all the above-mentioned reports substantiate the Recovery Plan to achieve handover within the Time for Completion. Once MARAFIQ approves this Recovery Plan, all planning and scheduling reports shall be corrected to reflect revised percentage progress and revised plan along with original percentage progress and plan. The Works shall be re-basing lined to reflect the revised Schedule.







7.6. PROGRESS REPORTING

No later than five (5) days prior to the last calendar day of the month, Contractor shall submit a two part monthly progress report to MARAFIQ:

7.7. NARRATIVE REPORT

The narrative report, in the form prescribed by MARAFIQ, shall consist of a general summary and descriptive data of contract progress, including description of any anticipated or actual variations from the Contract Schedule, an assessment of the impact of such variations, and a statement of proposed corrective action. The general outline for the narrative report will be the following:

Section 1 - General

Overall Project Summary

Cash Flow Forecast

Overall cost reporting inclusive of change order status

Areas of concern/claims

Progress curves

Man-hour forecasts

Change Order log

Engineering - percent completed (as applicable)

Procurement - progress matrix as Annex B

Construction - percent completed

Weather Summary

Milestones completed.

Summary Contract Schedule

Section 2 - Engineering

Progress - current status of the engineering activities such as drawings, system analysis, calculations, shop drawings, and as-built drawings.

Description of problem areas

Planned accomplishments for the next sixty (60) days including scheduled deliverables

Engineering drawing status report by major discipline

Design review status

Design trends status

Section 3 - Procurement:

Progress - current status of each activity in the procurement plan, including quantities of work completed both to date and for the period since the last report.

Materials and Plant status report keyed to the need for such, as given in the Schedule, including the current delivery schedule and identifying current material shortages, potential shortages, and a description of corrective action planned.

Section 4 - Construction:

Milestones (physical completion), status based on the Schedule.

Description of problem areas including corrective action planned.

Manpower summary, giving weekly averages on the job by craft, and also describing availability, shortages, absenteeism or similar problems.

Manpower forecasts for accommodation requirements.

Health, Environmental & Safety (accidents, deficiencies, lost time, action program).

Critical activities summary (i.e., activities which pace, or impact, the prosecution of the work in accordance with the Schedule.)

Security Incidents

Section 5 - Quality Control

Quality audits and corrective actions









Concession requests and status Inspection and testing status

Contractor shall prepare and submit within thirty (30) days of the Commencement Date, a cash flow plan for the entire performance period of the Works. The initial cash flow plan shall be representative of the Contractor's best estimate of total monthly cash requirements prepared in a form and manner agreed to by MARAFIQ, and shall be updated and submitted each month.

Contractor's detailed estimate of cash requirements may be required to support the cash flow plan. MARAFIQ may require additional information regarding Contractor's financial capability to insure that scheduled Contract progress is accomplished.

7.8. SCHEDULE

Contractor shall submit an updated monthly report on the approved Schedule.

The monthly update for the Schedule will consist of the following computer data, together with such other data as MARAFIQ may require:

Early start activity listing
Critical path listing
Activities by order of remaining float
Status of milestone activities
Changes in the logic or critical path in the Schedule.

The monthly update for the Schedule will consist of the schedule marked to show status of the activities shown, and revised to show the current schedule.

Contractor shall issue earned value engineering progress reports to MARAFIQ twice monthly. Contractor shall issue earned value construction progress reports to MARAFIQ on a weekly basis.

7.9. PERMITS & APPROVALS

The Contractor shall be responsible for obtaining all entry passes and work permits necessary for his personnel and equipment engaged in performance of the contract.

The Contractor shall adhere to all MARAFIQ Safety procedures for work permits, field jobs, the work force, equipment, tools and materials during the entire course of the project.

Work permits shall be received by Authorized permit receiver (APR) from Contractor side. Necessary training and validation of APRs will be arranged by MARAFIQ and the time of training will be intimated in advance.

Contractor shall take all precautions to safe guard against any risk of bodily harm / injury to persons or damage to property. Contractor shall provide safe and secure method of work in every aspect.

All safety requirements as per MARAFIQ safety procedure shall be met by the Contractor prior to the start of

job.

7.10. TIE-IN WITH EXISTING FACILITIES:

Contractor is responsible to get all necessary work permits from the relevant authorities to carry out the work on the existing systems for tie-in connections to the relevant systems.

Where the work requires shutdown of the necessary services, the Contractor shall schedule the tie-in works two months in advance in coordination with MARAFIQ Operations, through the MARAFIQ designated project

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engineer. All such tie-in / shut down schedules will subject to MARAFIQ agreement and approval. Contractor may request in advance the concerned plant shutdown schedule through designated project engineer from Marafiq Operation.

Contractor shall submit with the method of statement the work shall be done, a detail schedule and timing for each work requiring shutdown including necessary sketches.

7.11. HOLD POINTS FOR INSPECTION

Hold points for inspection shall be submitted by the Contractor for MARAFIQ review prior to start of the job. Contractor shall provide MARAFIQ with a detailed work schedule, and shall be notified 24 hours in advance on week day of all hold and witness points requiring inspection. Failure to provide such notification may result in the requirement for re-inspection or rework.

8 Installation, Testing & commissioning

The contractor shall be responsible for performing a complete installation, testing and commissioning after the rehabilitation/replacement completed, as specified, conforming to the MARAFIQ approved Scope of Work, professional standards of skill; performing work of a similar nature. Unless otherwise expressly provided herein, all materials and equipment shall be new and shall conform to the specifications, drawings, samples and other descriptions set forth in this contract or provided by contractor and approved by MARAFIQ.

8.1. FACTORY TEST REPORTS / CERTIFICATES

Contractor shall provide all the factory test reports/certificates for the piping and all other equipment, for Marafiq review & record.

Submit full test protocol for the factory testing consisting of both Type Testing and Routing Testing, certified test reports shall be provided. Copies of all the test results shall be included in the O & M manuals.

- Marafiq reserves the right to witness all tests. Contractor shall give two months (60 days) advance notice to the scheduled test.
- b. At least six (6) weeks prior to schedule test, the Contractor shall submit to Marafiq an Outline of the procedures used in performance of the test. This Outline shall include a brief description of the test equipment, connection diagrams, proposed test sheets, calculation and minimum/ maximum test and performance values which will be used to determine conformance with the specification and applicable standards.
- c. In the event of failure of any equipment to meet the test requirements, the Contractor shall obtain Marafiq permission before any repair or modifications are performed. If these repairs or modifications are in Marafiq's opinion likely to affect the result of any of the test previously carried out, then appropriate retesting shall be performed. Re-testing, repairs, modifications and replacement shall be completed within the scheduled time limits for delivery and at no additional cost to Marafiq.
- d. Upon completion of all testing, the Contractor shall submit four (4) copies of the certified report attesting that each test has been performed in accordance with the approved test procedures. The report for each test shall include the date of performance and name of the person in-charge of the test.







8.2. TESTING

All tests shall be performed in presence of MARAFIQ's representatives, if so desired by MARAFIQ. The Contractor shall give at least seven (7) days advance notice of site tests to MARAFIQ. Certified copies of all tests carried out at site shall be furnished in five (5) copies for approval of the MARAFIQ.

Detailed log sheet containing all related parameters for checking shall be maintained by Contractor during each testing and commissioning. It will be witnessed and signed by MARAFIQ. The parameter list for each test shall be mutually agreed between Contractor and MARAFIQ before starting the commissioning activities.

8.3. PRE-COMMISSIONING & COMMISSIONING

Contractor shall be fully responsible for pre-commissioning and commissioning of the new Installed system and handover to MARAFIQ in working condition.

Contractor shall assign/depute a dedicated team of skilled personnel for commissioning activity at site.

Following successful inspection and testing, the new facilities shall be commissioned and put on trial run for a week period.

Contractor shall provide commissioning and start up spare parts such as gaskets, bolts, etc. damaged during tests

8.4. TRAINING TO MARAFIQ STAFF

Contractor shall provide training on site for MARAFIQ O&M personnel. Training shall be conducted by qualified & competent personnel who are thoroughly knowledgeable with the theory, operation and maintenance of the new equipment.

8.5. SPECIAL MAINTENANCE TOOLS

Contractor shall provide special maintenance tools for all discipline works.

- Mark-VIe configuration software / Back up software -CD
- Display configuration software/ Back up software –CD
- Laptop containing above software with O& M instruction in English.

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9 Quality assurance

The contractor shall be responsible to ensure that workmanship provided under this contract is in compliance with the contract provision applicable codes and standard and sound engineering and construction practices.

10 Site acceptance test (SAT)

MARAFIQ shall have the right to witness at any time any test performed hereunder by Contractor or its vendors or Subcontractors, and Contractor shall give MARAFIQ reasonable advance notice of any such test in accordance with MARAFIQ requirements. The SAT, Site Acceptance shall be in accordance with accepted International Standards. SAT procedures shall be complete unto themselves. A full set of function simulation test for the all GTG1-8 with response checking shall be included.



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11 Equipment Maintenance requirements

11.1. Introduction

Marafiq require the Capital projects to deliver the desired benefits and opportunities. To deliver the project benefits and ensure a safe and reliable plant appropriate maintenance strategies must be in place. Maintenance strategies shall be delivered in the project phase to ensure the reliability, integrity and performance of the plant, as specified in the design phase, are achieved from start-up onwards in the operate phase.

Bids offered by equipment vendor shall specify the high level maintenance strategy required to achieve the required reliability of the equipment needed to deliver the project performance. The high level maintenance strategies shall detail the plant downtime; both planned and forced that has been assumed in the creation of the project proposal to meet the Marafiq performance specification.

Detailed maintenance strategies shall be delivered as part of the project delivery. The maintenance strategies shall not be generically specified but shall be based on the principles of Reliability Centered Maintenance (RCM) i.e. optimized for the function of the plant in the Marafiq operating context and site conditions. Justification of maintenance tasks shall be based on specified equipment failure modes, the characteristics of these failure modes in terms of MTBF, the consequences of failure based on Health, Safety, Environment, Asset damage, Production Loss and the cost of execution of maintenance including the resource and downtime costs.

To enable maintenance of equipment spare parts may be required. These shall be specified by the equipment vendor, noted in the respective maintenance task and offered to Marafiq through a Spare Parts Offer as detailed in the Marafiq Spare Parts Policy.

Where special tools are required for maintenance an overview shall be provided at the proposal stage and full details of the required tools provided with the spare parts submission. Required special tools shall be cross referenced in the maintenance tasks and Spare Parts Offer.

The following details are the general requirements for the development of equipment maintenance strategies and the minimum information required to be delivered as part of the project delivery. Maintenance strategies provided by equipment vendors shall be optimization to the normal operating context of the provided plant operating under its normal operating conditions within its normal operating envelope.

As part of the review of project Technical proposals the proposed high level maintenance strategies and detailed strategy and task development methodologies will be reviewed by the Marafiq Operations, Maintenance and Reliability departments. As part of the Commercial evaluation the proposed high level maintenance strategy planned and forced outage time required will be assessed to assure that the overall performance proposed meets the Marafiq project objectives.







11.2. Equipment Maintenance Strategies

Equipment maintenance strategies in projects for Marafiq Yanbu should be based on the principles of Reliability Centered Maintenance (RCM). Justification of maintenance tasks shall be based on the specified equipment failure modes, the characteristics of these failure modes in terms of MTBF, the consequences of failure based on production loss and the cost of execution of maintenance including the resource and downtime costs.

11.3. Specification of the Functions of the Asset

For all projects the functions of the asset should be specified related to Health, Safety Environment and Production functions. This functional specification may involve primary functions and secondary functions. The asset should to be systemized in logical plants, units and systems, and this systemization should be explained. The functions of the asset should be cascaded and specified to the functions at the level of these plants, units and systems - down to equipment level. For example STG Plant, Turbine Unit, Oil System and equipment such as pumps, motors, control panels, valves and instrumentation.

11.4. Critical Equipment List

For each function of the asset (for instance plant, unit or system) it should be specified which equipment can cause a failure to fulfil that function. All equipment that with one failure mode can cause a functional failure of the asset should be identified as critical equipment. In the list of critical equipment the failure mode of the equipment should be specified with the MTBF and the related functional failure of the asset.

11.5. Equipment Maintenance Strategies

Equipment maintenance strategies shall be specified for all equipment. The minimum data requirement for maintenance strategy is:

- Tag Number of equipment,
- b. Tag Description of equipment following the Marafig standard
- Equipment Type following the Marafig standard
- d. Discipline of equipment following the Marafig standard
- e. Maintenance Task Name
- f. Maintenance Task Description
- g. Spare Parts required linked to the Spare Parts offer
- h. Special Tools required linked to the Spare Parts offer
- . Task Frequency
- j. Man hours required based on task execution only
- k. Failure mode name related to the maintenance task

 I. Failure mode description related to the maintenance task
- m. MTBF of failure mode related to the maintenance task
 - . Consequence of failure specific to the Marafig context

The maintenance strategies including all the above information shall be delivered in the format defined in the Marafiq Document Control Standards. A covering report detailing and explain the analysis and development of the Maintenance Strategies shall be included as a project deliverable.







11.6. Maintenance Task Description

Maintenance Task descriptions should include sufficient information and be described in sufficient detail to permit the safe, effective and efficient execution of the task to the required quality. Task descriptions should be broken down into suitable steps and these steps assigned to appropriate technical skill groups, Mechanical, Electrical and Instrumentation for example. Task descriptions should include the required safety precautions needed to adequately isolate, immobilize and make safe the equipment in question.

It is not expected that the original equipment manufacturer will be able to identify specific isolation points, it is acceptable to note that isolation and or immobilization must take place and make allowance for the required isolation or immobilization point information to be entered by the engineering or system integration contractor.

Task descriptions should include specific quality criteria for the inspection, maintenance or repair work detailed in the task. Information such as maximum permissible vibration or wear allowance or other criteria such as lubricant condition shall either be included or have specific cross references to a location in the Operation and Maintenance Manual where the information can be directly found.

11.7. Documentation Requirements

The minimum data required for Maintenance Strategies as detailed above (2.3) shall be documented following the appropriate Marafiq standard format for entry into the SAP system and Document Control Standard. Documents relating to Maintenance Strategies shall be formally transmitted to Marafiq no later than the specified dates detailed in the Project Plan. This requirement shall include hardcopy and soft copy originals documentation, in the formats defined in Marafiq Document Control Standards, at various stages in the project, for example Concept, FEED, IFC and As Built etc.

11.8. Special Tools

A tool list should be provided of recommended tools (model, type, size) linked to the equipment they are used on and the maintenance task. Where multiple equipment items are purchased, there may be multiple tools offered, tool lists shall include cross references to minimise the multiple purchase and duplication of special tools.

List of recommended tools required for equipment maintenance in the project.

- a. Tool model, type and size.
- Tool description with use and specification.
- Number of tools recommended to be purchased.
- List of tag numbers of equipment the tools are used on.

12 Applicable Codes, Standards & Specifications

The Works shall be carried out in accordance with the relevant Standards and Codes.

The Codes and Standards listed below shall be considered as an integral part of the Scope of Work. Where discrepancy / inconsistency exist between these Codes and Standards, the most stringent application shall govern. Discrepancy shall be brought to the attention of Marafiq Representative prior to start of the activity. The Contractor shall ensure that the requirements of the Standards are compiled to, and that all the properties are design requirements, tests, inspections and other requirements are complied.

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Royal Commission Standards





Royal Commission (RC) Design Criteria, RC Guideline Specifications, RC Environmental

Regulations are to be followed for the execution of the Project wherever applicable, unless Otherwise specifically mentioned in the Scope or Specifications.

Comply with the applicable provisions of the codes and standards of the following Organizations:

OSHA	OCCUPATIONAL SAFETY AND HEALTH ASSOCIATION
SASO	SAUDI ARABIAN STANDARD ORGANIZATION
ASTM	AMERICAN SOCIETY OF TESTING AND MATERIALS
AWS	AMERICAN WELDING SOCIETY
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
NEC	NATIONAL ELECTRICAL CODE
ISA	INSTRUMENT SOCIETY OF AMERICA
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
API	AMERICAN PETROLEUM INSTITUTE
ASHRAE	AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR CONDITIONING
	ENGINEERS
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SSPC	STEEL STRUCTURE PAINTING COUNCIL
PIC-B-1216	INSTRUCTION MANUALS FOR GAS TURBINE GENERATORS
NFPA 70	NATIONAL ELECTRIC CODES
FM	FACTORY MUTUAL ENG. CORP.
RC-MYAS	ROYAL COMMISSION GUIDELINE SPECIFICATIONS
RC-ER	ROYAL COMMISSION ENVIRONMENTAL REGULATIONS
IEEE	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS
ICEA	INSULATED CABLES ENGINEERING ASSOCIATION
IEC	INTERNATIONAL ELECTRO-TECHNICAL COMMISSION
SSPC	STEEL STRUCTURES PAINTING COUNCIL
NEMA	NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION
UBC	UNIFORM BUILDING CODE
IBC	INTERNATIONAL BUILDING CODE
ASCE	AMERICAN SOCIETY OF CIVIL ENGINEERS
AISC	AMERICAN INSTITUTE OF STEEL AND CONSTRUCTION

Any conflict between the requirements of this specification and those on the attached drawings or in the codes, standards and specification referred to herein shall be brought to the attention of responsible MARAFIQ Engineer.

14.1. MARAFIQ Guideline Specifications & Standards

All materials and equipments furnished in accordance with this specification shall also comply with latest edition of the following sections of the Marafiq guide specifications.

S. No.	section	Specification
1	MQ-SP-A-2772	Paints
2	MQ-SP-A-2760	Plastering Plastering







3	MQ-SP-A-2770	Coatings for Concrete and Masonry
4	MQ-SP-S-2303	Non-Shrink Cementitious Grout
5	MQ-SP-A-2315	Concrete Rehabilitation
6	MQ-SP-A-2702	Masonry Mortar
7	MQ-SP-C-2005	Site preparation and Excavation & backfilling.
8	MQ-SP-A-2723	Damp proofing & Water proofing
9	MQ-SP-A-2732	Membrane water proofing for concrete structures.
10	MQ-SP-S-2300	Structural Design Criteria
11	MQ-SP-S-2302	Plain and reinforced concrete
12	MQ-SP-S-2303	Non shrink cementitious grout
13	MQ-SP-S-2305	Fabrication and installation of anchor bolts
14	MQ-SP-S-2311	Structural and miscellaneous steel fabrication
15	MQ-SP-E-6000	General Requirements – Electrical Equipment and Materials
16	MQ-SP-E-6001	Electrical Design
17	MQ-SP-E-6002	Electrical Requirements for Mechanical Equipment
18	MQ-SP-E-6005	Electrical Construction
19	MQ-SP-E-6006	Low Voltage metal Enclosed switch gear
20	MQ-SP-E-6008	Low Voltage 600V and below motor Motor Control centre
21	MQ-SP-E-6014	Building Electrical Design / Material and Installation
22	MQ-SP-E-6017	Electrical Testing
23	MQ-SP-E-6018	Low Voltage Power and Control Cable
24	MQ-SP-E-6019	Medium Voltage Power Cable
25	MQ-SP-E-6020	High Voltage Power Cable
26	MQ-SP-E-6021	Cable Tray system
27	MQ-SP-E-6022	Induction motor 200 Horse power and below
28	MQ-SP-H-4700	HVAC Design Criteria
29	MQ-SP-H-4701	HVAC Installation
30	MQ-SP-H-4705	HVAC Packaged Air Conditioning unit
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31 MQ-SP-H-4709	HVAC Controls
32 MQ-SP-M-403	B Painting
33 MQ-SP-M-403	Coating selection and application requirements for Industrial Plant & Equipments
34 MQ-SP-P-5001	Process and Utility Piping Design / Layout and Drawings
35 MQ-SP-P-5002	Material Specification line class – Process and Utility piping
36 MQ-SP-P-5003	Shop fabrication and handling – Process and Utility piping.
37 MQ-SP-P-5004	Field fabrication & Installation – Process and Utility Piping.
38 MQ-SP-P-5005	Internal Cleaning of Piping systems
39 MQ-SP-P-5006	Geographical color coding requirements
40 MQ-SP-P-5007	Bolt Torquing and tensioning requirements
41 MQ-SP-P-5008	Pipe makers and valve tags for commodity and safety ID
42 MQ-SP-P-5009	Piping Standard Details.
43 MQ-SP-P-5009 ATTACHMENT	
44 MQ-SP-P-5010	Pressure testing
45 MQ-SP-P-5011	Purchase Specification for Gate/ Globe and Check valve
46 MQ-SP-P-5015	Purchase specs for pipe, fittings & flanges.
47 MQ-SP-P-5016	Purchase specs for Bolts/Nuts and Gaskets.
48 MQ-SP-P-5018	Piping Tie- Ins
49 MQ-SP-P-5020	
50 MQ-SP-P-5021	Piping specifications for pipe bends
51 MQ-SP-P-5022	Traceability and certificates
52 MQ-SP-P-5023	Piping flexibility
53 MQ-SP-P-5023	Piping support elements.
54 MQ-SP-P-5029	Welding, NDE for shop & field fabrication piping.
55 MQ-SP-M-401	API 610/ISO 13709 10 th Edition – Centrifugal pumps for Petroleum petrochemical and Natural gas
56 MQ-SP-M-401	Horizontal end suction Centrifugal pumps for chemical Process



57	MQ-SP-M-4039	Coating selection and application requirements for Industrial plant and Equipment
58	MQ-SP-M-4045	Hot Insulation
59	MQ-SP-I-7013	General Design of Instrument Installation
60	MQ-SP-1-7022	Instrumentation For Package Equipment
61	MQ-SP-I-7016	Control Panels
62	MQ-SP-I-7012-1	Process Control- Distributed Control Systems
63	MQ-SP-I-7012-1	Process Control Programmable Logic Controller-PLC

14.2. ROYAL COMMISSION MYAS GUIDE SPECIFICATIONS

All materials and equipments furnished in accordance with this specification shall also comply with latest edition of the following sections of the RC MYAS guide specifications.

	Royal Commission Engineering Manual - Yanbu	
GDCTG - Sept 2007	Royal Commission Engineering Manual - Yanbu: General Design Criteria & Technical Guidelines - 3 rd Edition	
	Royal Commission Guideline Specifications - Yanbu	
Section	Name	
01011	General Design & Submittal Requirements	
01013	Training	
01017	Contractor Use of Premises	
01086	Color Codes & Color Standards	
01340	Shop drawings, Samples and Misc. Submittals	
01410	Quality Assurance	
01420	Quality Assurance/Quality Control	
01440	Quality Control	
01500	Temporary Utilities & Facilities	
01580	Project Identification & Signs	
01590	Field Offices & Sheds	
01600	Products, Materials & Equipment	
01610	Transportation & Handling	
01620	Storage & Protection	
01750	Operation & Maintenance Manuals - Industrial Projects Demolition	
02050	Demolition	
02100	Site Clearing	
02610	Pipe & Pipe Fittings	
02617	Steel Pipe	
02625	Glass Fiber Reinforced Plastic Pipe (GRP) - Seawater	
02713	Water Distribution Systems	
02723	Sanitary, Industrial Wastewater & Storm Sewer Systems	



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PROCUREMENT & والتقود

02813	Underground Telecommunication Duct banks & Jointing Chambers
02814	Underground Electrical Power Distribution Duct banks, Manholes & Hand holes
03100	Concrete Formwork
03200	Concrete Reinforcement
03300	Cast-in-Place Concrete
05120	Structural Steel
05500	Metal Fabrications
07100	Waterproofing and Damp proofing
07110	Membrane Waterproofing for Concrete Structures
09875	Corrosion Resistant Coatings
09900	Painting
09905	Field Painting
09906	Shop Painting
<u>15050</u>	Basic Materials & Methods – Mechanical
15051	Welding
15052	Flushing, Cleaning & Disinfections of Piping Systems
15053	Testing of Piping
15057	Welding, Brazing & Soldering
15080	Piping Specialties, Internal Pipework
15141	Centrifugal Pumps
16050	Basic Materials & Methods – Electrical
16150	Basic Materials & Methods – Electrical Motors Motor Starters & 480V Motor Control Centers
16155	Motor Starters & 480V Motor Control Centers
16450	Grounding
16910	Control & Instrument Wiring within Equipment

SAP PM Functional Location code & Equipment tagging reference

No.	Document number	Description
1	00280-PP-A0-1509-LJ	Legend & Symbol List
2	2758-EOM-0001	Legend & Symbol List
3	SAP PM Functional Location Code D	lirectory

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13 Duration of the Contract

The duration of the contract for the total completion of the Project will be Thirty Six (36) Gregorian months from the Notice to Proceed. This duration shall include design & approvals, Procurement, Construction, Obtaining permits, Installation, & Testing and Commissioning, and O&M Manual submission, including integration with the existing or new systems/projects.

The contractor shall recommended the Maximum shop prefabrication is required to minimize field erection labor and provide specific details of field tasks required to erect the Equipment.

14 Documentation for Marafiq Review & Approval

The Contractor's submittals shall include but not limited to, the following drawings, calculations and documents listed below:

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Legend and abbreviation drawing with equipment schedule section and equipment tagging Recommended Spare Parts List (RSPL)

Equipment schedules, which shall contain all required data, for example type of equipment, quantity, temperature, medium handled, pressure, and pressure drop and design condition. Area served, and location, shall be shown on the drawing plans. Each item of equipment schedule shall have the following:

Equipment number
Water quantities from each service
Equipment rpm
Unit type
Total pressure drop across each portion of equipment
Manufacturer and model number
Motor type, size, rpm, kW (hp), volts/phase/hertz

Mechanical

Mechanical design philosophy
Specifications and mechanical data sheets for all equipment and Valves.
General arrangement drawings for equipment's and packages.
P& ID Drawing
Structural shop drawings and calculations.
Fabrication and Assembly Detail drawings.
Pipe support details.
Material Selection diagrams (MSDs).
Material list used for the construction of piping, equipment's
Hydraulic Calculation
Piping Tie in Index.

Piping

Piping, piping material and valve specifications

Preliminary piping lay-out and pipe routing drawings to prove plot plant and equipment layout proposals
Tie-in details
Pipe supports details
General arrangement of piping and equipment layout.

Material Selection

Material Selection Philosophy and Selection References Design Life Specifications Corrosion Allowance and Mitigation

Automation & Instrumentation/Control

Automation and interface philosophy
Control system drawing
Instrument control loop diagram, alarms and connection to new control room
General specifications for instruments, cables and panels
Instrument data sheets and specification
Instrument installation schedule
Instrument Location plan







Instrument Installation drawing
General arrangement of Control panel
Control panel wiring drawing
Control Logic Drawing
Instrumentation and control panel grounding plan
PLC/ RTU input and output list

Civil and Structure

General specification for civil foundations for equipment Civil and structural design calculation Foundation repair work Drawing

Electrical

Electrical design philosophy (calculation, one line diagram, electrical layout drawings and conduit & cable schedule)

Specifications and electrical data sheets.

General arrangement drawings for equipments and packages.

Electrical Equipment List

Equipment sizing and selection basis report Electrical Equipment, Cable Routing and Earthing Layouts Control & Protection Schematic Drawings

Projects Turnover Documents

The following items are the MARAFIQ requirements for Projects Turnover: -

A) One (1) set of Original white prints Drawings (Signed & Stamped) & Two (2) copies. One (1) soft copy (Tiff or Pdf format) of drawings after being Signed & Stamped.)

Both of above shall be in accordance with attached "MARAFIQ official drawing template", "TITLE BLOCK" details and guidelines.

- Softcopy of All Drawings (CDs) MICROSTATION & TIFF formats
 The full drawing Number shall be the same as CAD file Number (Facilitates Searching process in SAP-DMS)
- 2. Softcopy of Drawings list in Excel format as per given format.
- Original (4) sets of O&M Manuals as per given RC guide line and cover sheet shall be as per attached document.
- 4. Softcopy of O&M Manuals Separately in OCR format
- 5. Original Hydro test report/ Certificate Original Pipe testing reports if applicable

Recommended spares and tools

- List of special tools required for initial installation and future maintenance.
- b. Recommended Spare Parts List for 2 years of normal operation of the system and equipment installed shall be prepared quantities and itemized prices with Proper coding and referencing of spare parts shall be done so that later identification with appropriate equipment shall be facilitated by the contractor and submitted for MARAFIQ review and approval during final commissioning phase of the project.



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- c. The supplier shall confirm that the GTG Rehabilitation package shall be supported for spare parts without becoming obsolete, at least for Twenty (20) years after the placement of order.
- d. Recommended spares and their quantities should take into account the related factors of equipment reliability, effect of equipment downtime upon production and safety, cost of parts and availability of vendor's service facilities around proposed location of equipment.
- e. All remaining commissioning spare parts need to transfer to Marafiq.
- f. Warranty period for spare parts should be provided by the contractor.
- g. Contractor shall submit the optional item for capital spare parts for whole life cycle of plants/ Equipment/ System

Contractor should submit the schedule of Valve list, Electrical items and Instrumentation list Inspection and Test Records

O & M Manual

Submit three (3 sets) of O & M Manual. Guide specification section No. 01750 is attached for reference.

- The O&M Manual, associated drawings etc. should be specific to the equipment installed at Marafiq and not of generic nature.
- The O&M Manual should contain:

Preventive Maintenance (PM) schedules, the PM activities that are required to be carried out for each PM, and expected duration of each PM.

Lubrication Chart with schedule of lubrication.

Periodic Inspection plan.

Detailed overhauling procedure/ Standard Maintenance Procedure.

A separate list of Protections and Interlocks associated with each TWS

- Binder Black folder with golden embossed titles.
- Binding of manuals shall be of corrosion resistant post screw type. Fillers shall be used to build the binding edge to the same thickness.
- 3) Soft copy of all the Manuals shall be provided in the soft copy in searchable PDF format.
- 4) Other than the technical requirements which is mentioned in the attached specifications; the following are mandatory in each manual:
- ✓ The mandatory requirement is Complete Table of Contents in all the manuals.
- Table of contents for individual book with page number and details of subtitles.
- Provide detailed of Work performed with interfaces, tag numbering and reference drawings.
- ✓ Provide contract specification, Scope of work "As Built Specification" with Final Documentation.

Drawings:

- A list of the drawings and other technical documents shall be submitted in the beginning of the contract to verify the completeness of the drawings and technical documents during the final as-built submission stage.
- RC CAD Standards and RC-General Design Criteria and Technical Guidelines shall be followed for the drawings.
- Attached standard title block shall be used by the contractors to generate the drawings. (PDF and DGN formats are attached)





4) All the drawings shall be submitted in the Microstation DGN format and the list of the drawings shall be submitted in the following excel format as a minimum.

Drawing list format in excel:

Sr#	Contract#	Drawing Number	Sheet No.	Rev.	Date	Drawing Title	Dwg. Path in CD
1.	7200005009	05009-IN- A1-001	1	1	dd-mm- yyyy	xxxxx	D:\7200005009\IN\05009- IN-A1-001.dgn

15 Safety

The Contractor shall comply with the Marafiq safety procedures outlined in Attachment A – General Terms and Conditions Section from section GC.25 to GC.32 inclusive.

16 Scope of work

The work involving is to replacement the compressor and Turbine Rotor of Hitachi Gas Turbine Generator 1,2,4,5,6,7 and 8 model frame 7001E (Hitachi Manufacturing). The contractor shall conduct Engineering work, performance Testing, Reporting and Recommendations. The scope of work of this to contract is to achieve the following:

- A. Replacement of Cooling Water Radiator Skids for GTG Units 1 8
- B. Installation of NOX Control System for GTG Units 1 8.
- Upgrades of Speed Tronic from Mark V to Mark Vie for GTG Units 1 9.
- D. Replacement of Compressor Assembly & Un-bucketed Turbine Rotors of GTG # 1 8 except GTG No.3.
- E. Extendor Parts of GTG# 1-8
- F. Full unit uprates of GTG# 1-8 except GTG No.3
- G. Rewinding of Generators for GTG Units 1 7.
- H. Replacement of AC/DC Power, Control & Instrumentation Signal Cable for GTG Units 1 8.
- Replacement of exhaust plenum for GTG units 1-8.
- Replacement of shut off & By pass damper geared motor for GTG units 1-8.
- K. Replacement of Protection Relay by Digital Type of GTG unit 1, 2, 3, 4, 7 & 8.
- L. Replacement 600 V Draw out Metal Clad Switchgear for GTG 1,2,4,7 & 8.
- M. Replacement Generator Breaker of GTG unit 1, 2, 3, 4, 7 & 8.
- N. Replacement of Hydrogen Control Panel for 3 8.
- Replacement of AVR by Digital Excitation System for GTG Units 1 8.
- P. Installation of HVAC System and Hydrogen Detectors inside DC Compartment for GTG Unit 1-8
- Q. Replacement of MCC for GTGs 1 7.
- R. Replacement of Gas Flow meter & other Field instruments for GTG Unit-1 to 9
- Replacement of 4.16 kV Switchgear for GTGs # 1,2,3,4,6,7 & 8
- T. Supply of 2 No's (GTG) Secondary Unit Auxiliary 4.16kV/0.48kV Dry type transformers (To be kept as spares)
- U. GTG Performance Test and Training.
- V. Training to MARAFIQ Staff

All above mentioned are detailed in the following chapters.









SECTION – IV DETAIL SCOPEOF WORK





SECTION - IV A

REPLACEMENT OF COOLING WATER RADIATOR SKID FOR GTG UNITS 1-8





I. GENERAL INFORMATION

1. Existing System

The existing unit installed in 1982 has completed 30 years of service and have been deteriorated due to corrosion and long service life.

Especially during summers, Marafiq experiences turbine trips on high lube oil temperature (exceeding alarm set point 74°C) & high hydrogen gas temperature (exceeding alarm set point 80°C) due to poor heat transfer across radiator (just 1 deg.C drop of cooling water temperature) due to excessive deposit on tube fins. Also the radiator skid structure is de-laminated and corroded.

2. Proposed Modification

Marafiq is considering replacement of complete "Turbine & Generator Radiator cooling water skid system" along with skid structure and auxiliaries as a package unit with a new unit for each Gas Turbine Generators (for GTG 1 to 8). The existing 56.2 MW Gas Turbine Generators Frame 7001E (for GTG 1 to 8) is Hitachi Manufactured, licensed from GE. Further, each of the two gas turbines is connected to one HRSG. The proposed modification consists of

- a. Installing the new complete radiator skid.
- Modify the existing cooling water (for turbine/ generator) supply/ return piping to old radiators and re-route the pipelines to the new equipment.
- c. The cooling water supply line above ground shall be provided with cold insulation.
- Installation of cooling water pumps under the heat exchanger and piping connections for surge tank and cooling module.
- e. Tie in the utility connections to the existing ones
- Tie in drain line to sewer line, as shown in AR10695-PD-A1-005-A sheet 1 & 2.
- g. Cabling from new MCC room to electrical drives for Cooling pumps (2 nos per module- 1 duty+1 standby) and heat exchanger fans (6 nos per module, 3 nos per radiator bay).
- Grounding to network grid.
- i. Fitting of instruments of supply & return lines.
- Painting of piping as per standard & arrow marking of pipe lines.
- k. Pipe supports to be provided as per stress analysis calculations.
- Hydrostatic testing of piping.
- m. Flushing of piping to remove the loose debris.

3. Inspection and Testing

Provide all test instrumentation, equipment and accessories necessary for demonstration and putting the equipment into operation before commissioning. All testing equipment shall be calibrated by approved authorities and calibration certificates shall be submitted to Marafiq representative for their review and approval.







a. Factory Test:

Submit full test protocol for the factory testing consisting of both Type Testing and Routing Testing, certified test reports shall be provided. Copies of all the test results shall be included in the O & M manuals.

- 1) Marafig reserves the right to witness all tests. Contractor shall give advance notice to the scheduled test.
- 2) At least six (6) weeks prior to schedule test, the Contractor shall submit to Marafiq an Outline of the procedures used in performance of the test. This Outline shall include a brief description of the test equipment, connection diagrams, proposed test sheets, calculation and minimum/ maximum test and performance values which will be used to determine conformance with the specification and applicable standards.
- 3) In the event of failure of any equipment to meet the test requirements, the Contractor shall obtain Marafiq permission before any repair or modifications are performed. If these repairs or modifications are in Marafiq's opinion likely to affect the result of any of the test previously carried out, then appropriate re-testing shall be performed. Re-testing, repairs, modifications and replacement shall be completed within the scheduled time limits for delivery and at no additional cost to Marafig.
- 4) Upon completion of all testing, the Contractor shall submit four (4) copies of the certified report attesting that each test has been performed in accordance with the approved test procedures. The report for each test shall include the date of performance and name of the person in-charge of the test.

b. Site Test:

Carry out all site tests in accordance with the approved test procedures, codes and standards to ensure that the equipment and the control accessories comply with the specifications and operational requirements. All tests shall be subject to witness by the Marafig representatives.

- At least eight (8) weeks prior to schedule test, submit to Owner an Outline of the procedures used in performance of the site test. This Outline shall include a brief description of the test equipment, connection diagrams, proposed test sheets, calculation, reference drawings and minimum/ maximum test and performance values which will be used to determine conformance with the specification and acceptability of the equipment and installation.
- 2) Upon completion of the installation and prior to final acceptance, each equipment/ unit shall be tested to the complete satisfaction of Marafiq. Shall provide all test instrumentation, equipment and accessories necessary for demonstration and putting equipment into operation. Before commissioning, the Contractor shall submit all necessary calculation & performance curves; relay setting and coordination curves to Marafiq for approval.
- 3) The test procedure shall contain but not be restricted to the following:
 - Check for completeness.
 - Hydrostatic testing of Piping/ equipment.
 - Electrical tests, i.e. insulation resistance test, polarization index measurement, etc
 - Operational and Functional test

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c. Testing Requirements:

All non-destructive testing will be in accordance with the requirements of ASME Section VIII, Div. 1. All weld joints shall be examined by dye penetrant.

The tube bundles and piping will be hydro-tested with water in accordance with the requirements of ASME Section VIII, Div. 1.

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The tube bundles will be flushed with rust inhibiting water solution to remove any loose debris. After flushing, the modules will be drained, dried and all openings will be sealed. Each module will be run tested prior to shipment. The results of airflow, noise and vibration tests will be reviewed and documented for compliance with the design requirements

d. Acceptance Criteria

Operation and test run of each GTG's "Turbine and/ or Generator Radiator water cooling skid" as one package unit, to ensure that cooling water temperature difference shall maintain at least 6 °C continually for two months (July & August) during peak summer season and having been successfully run under various combinations of GTG loads, ambient temperature and relative humidity.

The Cooler that shall capable of providing 100% of the cooling needed at worst scenario.

Reduced lube oil temperature and increased unit output.

No effect on emission or fire temperature.





II. TECHNICAL REQUIREMENTS

1. Brief Work Description

The scope of work includes but not limited to, engineering, design, procurement & installation of radiator skid cooling modules with necessary piping modification/tie-in to existing GTG units and installation of supply/return cooling water lines. It includes installation of additional isolation valves, pipeline insulation (for above ground pipes) and pipe supports. Existing Radiators shall be demolished and connecting piping shall be blinded.

The Contract shall be executed as an Engineering, Procurement and Construction (EPC) Contract. The replaced new GTG- Radiators shall have satisfactory and trouble free operation with enhanced higher cooling capacities especially during summer season.

All work performed shall be in accordance with governing codes, regulation, standards, specifications and Scope of Work (SOW). In case of conflict between SOW and standards / specifications, the content of the SOW will prevail.

Installation shall be executed in phases on each GTG's to reduce downtime on the respective GTG, and to have its final acceptance and test run before going to another phase replacement.

Contractor shall prepare a risk analysis, work method statement, inspection and test plans for this project for Marafiq approval.

2. Scope of Work

2.1. General

- Contractor shall perform site survey, and field measurements necessary for the detailed design of the project.
 Contractor performs study and design of the upgraded cooling system process and shall size all equipment, piping, cabling and accessories.
- Contractor shall prepare the installation and general arrangement drawings and properly describe, detail the
 various parts of the work to be performed in the fabrication and installation thereof, including the preparation
 of plans, design calculations and drawings.
- c. Contractor shall furnish all construction services and construction equipment as required for accomplishing and performing the work, including, but not limited to, all supervision, labor, erection and installation services, haulage, temporary structures/by pass lines as necessary, consumable materials, tools and equipment.
- d. Contractor shall present to Project Engineer an itemized list of all equipment and tools (other than hand tools), including but not limited to welding machines, pumps and compressors at the time of any Construction Plant being moved on to the Site. Said list must include description and quantity. Prior to removal of any or all Construction Plant from the Site, Contractor shall clear such removal through Project Engineer.

2.2. MECHANICAL & PIPING WORKS.

A. Piping







- a. Supply and deliver all piping, fittings, flanges, valves, bolts, gaskets, consumables, insulation and cladding necessary to complete the new 250 mm dia supply and return piping installation for GTG 1 to 8 turbine and generator radiators. However the bidder should confirm the pipe size according to the flow required to turbine and generator by required design calculation.
- Modify existing Cooling water supply and return piping. Provide caps and blinds to the radiator piping. 200
 mm dia supply and return pipe may be re-used as indicated in the drawing.
- c. Supply and provide wye strainers, drains and vents, orifice flanges/ plates, instrument nozzles, sampling points and connection points for testing and for charging ethylene glycol water mix.
- d. Supply and provide valves as required or shown in the drawings.
- Fabrication and installation of piping and pipe supports. Contractor shall be responsible in routing the piping and providing the appropriate support on the floor
- f. Tie-in of new piping to existing lines and header.
- g. Supply and Installation of cold insulation and cladding for the supply water line for cooling water module to turbine and generator.
- Supply and Installation of make-up water line (process water) for the radiator surge tanks similar to the existing System in GTG -9.
- Supply and installation of filling facility for the ethylene glycol water mix, (Aqua guard or equivalent recommended by Radiator manufacturer)
- Internal and external cleaning of new cooling pipes.
- k. To make the Provision for sampling the Cooling water line inlet and outlet Pipe line.
- Testing and inspection. The new cooling water lines shall be inspected and tested prior to tie-in and commissioning.

B. Mechanical Works

- a. Design, procurement, fabricate & install Cooling water radiator skids module. Each Cooling water module shall consist of Two (3) forced-draft air-cooled heat exchanger, cooling water circulation pump (1 duty+1 Stand by), skid structure, piping, static head/expansion tank, valves, gauges, switches, thermometers and wiring.
- b. Each air cooled heat exchanger shall consists of three (3) (2 duty +1Stand by) forced draft fans and shall be capable of cooling 1127 GPM of 30% Ethylene glycol / water mix from 169°F to 142°F while rejecting air at an ambient temperature of 122°F. Normal operation will be to cool the mixture from 156°F to 142°F. Forced-draft air-cooled heat exchanger shall be shipped as a factory-assembled unit complete with fans, motors, and drives.
- Each fan motor and its space heater, and vibration switch shall be factory wired to a terminal box located on that bay.
- Each pumps, piping, valves, switches, and main terminal box shall also ship as a factory-assembled unit.
- e. The skid structural, heat exchanger isolation valves, piping spool pieces connecting the heat exchanger to the pump skid, flange gaskets for interconnecting piping, static head/expansion tank and its valves, piping, level gauge and switch, and thermometers, shall be field installed.
- f. Shop Hydro test the entire cooling water module and check the piping fit-up.
- g. Each exchanger shall be factory run tested prior to shipment to confirm that airflow and vibration complies with the design requirements and there is no excessive noise.





- Tube bundles shall be purged and pressurized with nitrogen and capped with piping spool pieces, prior to shipment.
- All non-destructive testing shall be in accordance with the requirements of ASME Section VIII, Division 1 (stamped).

C. Design parameter:

- Pump shaft will be made of solid 316 Stainless Steel, with two pumps (1 duty+1 standby) per cooling module.
 Pumps will have common discharge connection.
- Noise level for the whole module will meet 85 dB (A) at 3 feet.
- The cooling water module will have 2 redundant fans per bay and the module shall operate with 4 out of 6 fans in operation (N-2).
- The fouling factor of 0.001 h sq.-ft. °F/Btu shall be considered

Heat Load capacity

Existing Heat Transfer capacity in MBTU		Contingency Allowance in Mil BTU		Total in Mil BTU
Turbine	Generator	Turbine(50% load margin)	Generator(15% load margin)	
6.096	3.513	3.0	0.5	13.1

Note: Temporary Cooling arrangement shall be considered during replacement of Radiator skids.

D. Technical specifications:

Specifications of existing radiators for reference are as follows, which shall be enhanced for higher cooling capacities and replaced with new radiators;

- a) Generator radiator datasheet (refer attachment)
- Turbine radiator datasheet (refer attachment)

E. Materials & construction

A- Finned Tube Bundle

<u>Tubes:</u> 254 tubes with a staggered triangular tube layout arrangement, Welded carbon steel, 1.0" OD with a thickness of 0.0787".

Fins: The fins will be constructed from aluminum 1060, and wound under tension (L-footed).

<u>Header Boxes</u>: The header boxes will be the plug type fabricated from carbon steel and is designed with a corrosion allowance of 0.059".

<u>Bundle Frame</u>: Tube supports fabricated from A-36 steel will be bolted to the side frames above and below the finned tube bundle assembly. The spacing of the tube supports will not exceed six feet. To assure maximum airflow across the finned tubes, heavy gauge galvanized sheet steel air seals will be installed both at the sides and ends of the tube bundle assembly. The entire tube bundle framework assembly will be hot dip galvanized after fabrication.







B- Support Structure

The tube bundle assemblies will be mounted on a self-supporting carbon steel structure. The support structure will be hot dip galvanized after fabrication.

C- Fans and Drives

The forced draft fans for each exchanger will be of the manually adjustable pitch type with airfoil shaped blades fabricated from aluminum. Each fan drive assembly will be complete with a manual reset vibration switch.

The power requirement for the fan motor shall be specified by contractor.

Other utility requirements are as follows.

1. Fan Driver: 460 Volts 2. Pump motor: 460 Volts

3. Motor space heater: 120 Volts

4. Fan vibration switch: 24 to 240V ac/dc



D- Cleaning and Testing

All non-destructive testing will be in accordance with the requirements of ASME Section VIII, Div. 1.

The tube bundles and piping will be hydro-tested with water in accordance with the requirements of ASME Section VIII, Div. 1.

The tube bundles will be flushed with rust inhibiting water solution to remove any loose debris. After flushing, the modules will be drained, dried and all openings will be sealed.

Each module will be run tested prior to shipment. The results of airflow, noise and vibration tests will be reviewed and documented for compliance with the design requirements.

E- MATERIALS

All materials to be used in this project shall be approved by Marafiq. The use of a manufacturer's name, model and catalog number is for the purpose of establishing the standard of quality and general configuration desired. Other manufacturers may be submitted for approval by MARAFIQ.

Materials incorporated into the systems shall be new and free from defects and imperfections.

A) PIPING CLASS CARBON STEEL

Description	Material specifications			
Pipe 50 mm and below	Carbon steel API SL or ASTM A 53 Gr B schedule 80 seamless			
Pipe 65 mm and above	Carbon steel API SL or ASTM A 53 Gr B sch 40 seamless			
Fittings 50 mm and below	Carbon steel ASTM A 105 Gr B 3000 # SW			
Fittings 65 mm and above	Carbon steel ASTM A 234 Sch 40 Butt weld			
Flanges 50 mm and below	Carbon steel ASTM A 105 ANSI 16.5 150 # RF SW			
Flanges 65 mm and above	Carbon steel ASTM A 105 ANSI 16.5 150 # RF BW			
Bolts/Nuts	Carbon steel ASTM A 193/ ASTM A 194			
Gasket	150 # Spiral wound Flexitallic 55304 Asbestos free with CS external Centering ring			



PROCUPLIFICATIONS

RECOURACTS TEPT.

Valves, Globe	Carbon steel ASTM A105; 800# SocketweldF6a trim/satellite integral seat OS & Y		
Valves, Gate	Carbon steel ASTM A105;800 #Socket weld F6a trim/satellite integral seat OS & Y		
Valve , Butterfly	Carbon steel, ASTM A 216 WCB, 150# lugged type, gear operated		

B) STRUCTURAL

Description	Material specifications	
Structural Shapes and plates	Carbon steel ASTM A 36 Galv	
Weld rod	E-7018	

C) SHADE FOR RADIATOR UNITS

The Contractor shall provide shade to the radiator assembly to protect the equipment's. The design must be made such that there would be no restriction of natural air flow and that the cooling efficiency of the radiators shall be kept at its designed capability. The shade shall be made of galvanized steel structure on top of concrete pedestals. Top coat painting for steel structural members shall be in accordance to Marafiq Guideline Specifications and Standards Section MQ-SP-A-2772. Roofing shall be pre-fabricated and pre-painted 75mm thick sandwich panel with 0.70mm thick galvanized skin. Ridge roll and side flushing shall be Ga. 20 galvanized and pre-painted metal sheets.

D) PAINTING

As per attached painting specifications 09900, 09905, 09906 and 09907.

E) INSULATION

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Description	Material specifications	O O O O O O O O O O O O O O O O O O O
Material	Fiberglass or equal	Co
Thickness	25 mm	7010223311
Jacketing	Aluminum sheet	
Thickness	0.4 mm	

F) FIXING WIRE

Description	Material specifications
Material	Stainless steel wire
Size	1.0 mm dia.

G) Strap

Material : Stainless steel 304s, 0.38 mm thick x 15.9 wide

Set Screw : Stainless steel

2.3. ELECTRICAL WORKS

As a minimum, the Electrical works shall consist of following:

a. Modify existing Motor Control Centre (MCC) for Cooling Modules to suit the new capacities.





- b. Provide new motor starters in the MCC for the new off-base industrial cooling modules, for installation on the existing two gas turbine generator units including engineering, material, labor and documentation. The field modification shall involve removal of existing motor starters (on existing turbine & generator radiators) including number of spare motor starters that will be needed by the installation and replace it with new motor starters to suit for the new turbine and generator radiators installation. Installation of power supply and all other needed for the proper operation of the motors based on the new locations. Each MCC to include vertical sections of GE MCC's with the following motor starter units:
 - 1. FVNR CB (Size to be specified by contractor)combination starters each with:
 - a. CPT (Size to be specified by contractor)
 - Standard ambient compensated O.L. relay
 - c. Indicating lights
 - d. Auxiliary Interlocks
 - e. Spring return 3 position selector switch
 - FVNR CB(Size to be specified by contractor) combination starters each with:
 - a. CPT(Size to be specified by contractor)
 - b. Standard ambient compensated O.L. relay
 - c. Indicating lights
 - d. Auxiliary Interlocks
 - e. Spring return 3 position selector switch
- c. Field wiring for the pump motor and its space heaters, and switches to the main terminal box (NEMA 4) located on the skid
- d. Field wiring between the terminal boxes (NEMA 4) on each heat exchanger bay, the liquid level switch, and the main terminal box on the pump skid.
- e. Field wiring for the cooling fans from skid to existing MCC with complete accessories for proper operation.
- Shift and deliver safely all the dismantled material from the site to MARAFIQ Yanbu warehouse.
- g. Design, furnish, install and test all electrical equipment, cabling, grounding and accessories for the Cooling Module.
- h. Grounding for turbine and generator radiator skid and connect the ground wire to existing grounding system.
- Refer to electrical drawings nos. AR10695-EE-A1-001-A & AR10695-EE-A1-002-A, see attachment, for layout and single line diagram (preliminary only for bidding purposes).

2.4. INSTRUMENTATION WORKS

As a minimum, the Instrumentation works consist of following:

- Contractor shall provide local field instrumentation like level gauges, pressure gauges and bi-metal type temperature indicators for local indication.
- b. The common discharge piping of the cooling water pump (Two 100% capacity pumps-one duty, other standby) shall be provided with one pressure gauge, pressure switch and one orifice plate between flanges (each of them equipped with pressure test point with ball valves. There will be two 100% capacity pumps; only one pump at a time is required to operate at any time during normal operation. The second pump is provided as a back up and will start automatically if the primary pump loses pressure. A pump discharge pressure switch set to actuate at low pressure shall provide a control signal to the upgraded SPEEDTRONIC™ Mark-VIe gas turbine control system to start the second pump (Standby).



- c. Each pump of cooling water module shall be provided with duty/standby selector switch in addition to the Hand/Off/Auto Switch. In remote mode, manual/automatic option shall be provided and configured for control and operation of each pump in the upgraded GTG Mark-Vie control system. In automatic mode cooling water pump shall be operated automatically by GTG control system based on the logic configured for pump discharge pressure switch. While in manual mode, cooling water pump shall be controlled and operated by operator in the field. Pump (duty+ standby) Start/Stop, run, trip signals shall be interfaced to existing GTG Mark-Vie control system using spare input/output channels for integration to UCS. Refer to the P&ID drawing# AR10695-IN-A2-001 for proposal.
- d. Each radiator fan of cooling water module shall be interfaced with upgraded GTG Mark-VIe control system for automatic start based on the cooling water outlet temperature discharged from the radiator. Radiator fans (duty+ standby) Start/Stop, run, trip signals shall be interfaced to upgraded GTG Mark-VIe control system using spare input/output channels for integration to UCS. Refer to the P&ID drawing# AR10695-IN-A2-001 for proposal.
- e. Interface and integrate GTG radiator process signals (temperature signals) to existing GE Mark-V control system. Process signals shall be configured in Mark-VIe and associated HMI including the graphic modification and development of graphic pages. Spare I/O will be utilized for interfacing and integration of cooling water inlet and cooling water outlet temperature signals for each GTG radiator.
- f. Cooling water module inlet /outlet piping shall have 1-1/2" flanged thermo well for temp sensors. Temp sensors will be wired to field mounted smart transmitter. Transmitters' signals will be connected to Mark VIe control system. Mark-VIe will exchange the data signals to existing ABB UCS through existing serial Modbus link. Additional hardware, software is not required for ABB UCS.
- g. Cooling Water Module shall have Flanged type microprocessor based Electromagnetic Flow meter to monitor and log the cooling water supply flow to radiator. The Contractor shall design, supply, install and test electromagnetic flow meter for each cooling water module. Flow meter signal shall be interfaced and integrated to upgraded Mark Vie and ABB UCS. The Electromagnetic Flow meter shall be of carbon steel 150#RF, flanged to ASME B16.5, type having SS tube with Teflon liner and SS316L electrode with remote mount transmitter cum converter. Enclosure of Electromagnetic Flow meter shall be of NEMA 4X.
- h. Each GTG radiator temperature signals shall be configured in Tenore Servers, Operator Work stations in GTG Local Control Room building #11B and Tenore Servers, Operator Work Stations of GTG cluster in Central Control Building CCB#13. Graphic display pages will be modified, alarms, reports will be configured in existing HMIs in GTG Local Control Room and Central Control Room. Modification, updating of tag database for MIS, reporting system including updating of report server, alarms, reports for remote monitoring, logging and analysis purpose in GTG local Control Room and Central Control Building.
- i. The Contractor shall approach GE for interfacing and integrating radiator signals to upgraded Mark-VIe GTG control system. Existing signals like level switch, vibration switch, fan motor signals, pump motor signals which are configured in existing Mark-V shall be interfaced with new radiators and upgraded Mark-Vie. New process signals like cooling water supply and cooling water return temperature signals, pump run/trip status, radiator fan run/trip status, cooling water pump discharge pressure signals shall be interfaced to spare channels of existing MARK-V control system and same process signals shall be configured in Mark-V including configuration of alarms, modification of dynamic display/graphic page of GTG HMI. The contractor shall develop; configure interlock, control/logic in Mark-VIe GTG control system for automatic start of standby cooling water pump based on the pressure switch signal. The contractor shall also develop; configure interlock, control/logic in Mark-VIe GTG control system for automatic start of standby cooling water pump based on the cooling water outlet temp discharged from the cooling water modular start in log can say fan based on the cooling water outlet temp discharged from the cooling water modular start makes the cooling water modula

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 Cooling Water Module radiator shall have facility for automatic filling of water in header tank. The Contractor shall provide all required instrumentation for automatic filling of water to header tank of radiator.

2.5. CIVIL WORKS

As a minimum, the civil works shall consist of following:

- a. Modification or demolition of existing portions affected by the installation.
- Excavation and backfilling of concrete foundations, plinths, manholes, duct bank (if required), pipe/electrical trenches with covers (if required), etc.
- c. Concrete pouring, application of damp proofing and membrane waterproofing to all concrete surfaces.
- d. Fabrication and installation of pipe and conduit supports, etc.
- Modification of existing walls and cladding affected by protruding pipes, conduits, etc.
- Installation of 100 mm dia uPVC sch 80 industrial wastewater drainage line interfaced to the nearest existing drainage manhole.
- g. Fabrication and installation of new pipe supports for the new piping.
- h. Fabrication and installation of Radiator skids access platforms and ladders.
- i. Painting /touch- up for surfaces of existing structure damage during welding works
- Restoration of all affected structures and final site grading.
- k. Dispose construction unsuitable materials and debris.
- I. Shade for Radiator units



2.6. PAINTING WORKS

As a minimum, the painting works consist of following:

- Internal and external surfaces shall be cleaned, primed, and field painted in accordance with the RC specification no. 9900, 9905 & 9906 respectively.
- Paint all the proposed carbon steel lines including all fittings, valves and pipe supports / hangers as per applicable standards and color codes.
- c. Painting works also include any structure affected by this modification works.
- All supplied pipes and fittings should be provided with pipe color coding and flow direction.

2.7. EXECUTION

The installation shall be as per the following requirements:

- Shall work under the supervision of competent and experienced engineer for all work related to the demolition of existing tank/piping and installation, testing and commissioning of new equipments.
- b. Shall procure and deliver to site all items and respective accessories required for proper installation of operating system, and shall make suitable arrangement at site for the storage of equipments and accessories as recommended by manufacturer.
- c. Shall provide all construction equipment including crane, fork lift, welding and cutting machine, air compressor, scaffolding and labor as deemed necessary for the proper execution of the work.





- d. All the works shall be performed in a professional manner, in accordance with the applicable codes and standards and best engineering practice. Work shall be performed by skilled workers equipped to produce satisfactory results in a safe and substantial manner so as to avoid undue stresses.
- Implementation of all applicable manufacturer's standards and otherwise specified quality control, inspection and testing procedures.
- f. Installation of all power and control cables and grounding conductors for grounding and cathodic protection, if necessary. Joints are not allowed in cables.
- g. All electrical, instrumentation, civil, structural and mechanical works required for proper installation of equipments including the MCC.
- Shall be responsible for the completeness of the erected equipment and shall test and verify the operations of all equipments/ components, controls and auxiliaries devices.
- i. Shall be responsible for installation for grounding the equipment to the plant ground grid.
- The installation of new GTG Radiator skids and its auxiliaries shall be in accordance with Manufacturers recommended procedure and applicable standards subject to MARAFIQ approval.
- Shall connect the drain network to the new drain line; refer to AR10695-PD-A1-005-A.
- Contractor shall supply the initial charge of 30% ethylene glycol/water mixture during the testing and commissioning.

2.8. REFERENCE DRAWINGS:

The following reference drawings provided herewith are for concept only:

S. No. Drawing Number AR10695-PD-A1-005 (2 sheets)		Drawing Title		
		General arrangement and Piping Layout for new radiators (Sheet1- manhole near O&M Bldg; Sheet2- manhole near GTG-1)		
2	AR10695-EE-A1-001	Proposed Electrical Layout for New radiators		
3	AR10695-EE-A1-002	Single line diagram for New radiators		
4	AR10695-IN-A2-001	P& ID for Radiator Installation for GTG 1 & 2		
5	AHG-PP-A0-0013	Piping arrangement at Gas Turbine area, for fire water connection		
6	00135-EE-A0-050	Outdoor distribution network, key plan for electrical duct bank		
1 113778-7.1 E-MILIES		Transformer, Firewall, Cable pit, Oil Pit and Sunshade fdn for Unit 1-8 Plan, sections and Details		
8	01490-CE-A1-DB-026	Underground Duct Profile		







SECTION – IV B INSTALLATION OF NOX CONTROL SYSTEM FOR GTG UNITS 1-8







SUMMARY OF THE WORK

1 SITE LOCATION

Power and Water Utility Company for Jubail & Yanbu (MARAFIQ) proposes to NOX Control system of GTG plant at Madinat Yanbu Al Sinaiyah (MYAS), which is located on the Red Sea coast approximately 300 kms. to the North of the city of Jeddah in the Kingdom of Saudi Arabia.

2 DESCRIPTION OF WORK

A. Scope of Work:

 The work of this contract includes complete responsibility for all detailed engineering, design, procurement, manufacturing, construction, testing, commissioning and startup of NOX Control units complete with all utility connections, at Madinat Yanbu Al-Sinaiyah (MYAS) Power, Desalination and Seawater Cooling (PD&SC) Facility of MARAFIQ.

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OPTION - 1

Centralized Water Injection Package to control the NOX on the primary Fuel (Sales High Pressure Gas) and Backup Fuel (Light Fuel Oil) as per environmental control RCER to manage emissions and discharges. the RC Requirement less than 80 PPM in Variance of load condition, complete with all required auxiliary and accessory equipment, instrumentation, controls; and utility connections, DM Water Transfer , Storage and Distribution.

OPTION - 2

The bidder shall submit along with the alternative proposal for DLN System to control the NOX on the primary Fuel (Sales High Pressure Gas) and Backup Fuel (Light Fuel Oil) as per environmental control RCER to manage emissions and discharges RC requirement less than 80 PPM in variance of Load Conditions, complete with all required auxiliary and accessory equipment, instrumentation, controls; and utility connections.

THE SPECIFICATIONS AND DOCUMENTATION HAVE BEEN DEVELOPED FOR THE BOTH OPTIONS; MARAFIQ HAS THE RIGHT TO SELECT THE OPTION.

Major elements of the work include:

- Utilization, integration, sharing and, where necessary, expansion of applicable existing facilities, equipment and systems.
- Civil, structural, mechanical, electrical, instrumentation and controls, corrosion control, and all required interface and integration connections to existing site equipment, facilities and utilities, as applicable.
- The Contractor shall as part of his full responsibility and scope, check the ratings and/or sizes and/or
 quantity of systems components whose ratings or sizes are specified in the Contract documents. When
 this check indicates that the specified ratings or sizes are not adequate then the Contractor shall make

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- Work shown upon the drawings and not mentioned or described in the Specification and work described in the Specification and not shown on the drawings will be held to be included in this Contract.
- B. The scope of work includes all elements, items, components, units, parts and efforts required to provide complete, functional systems and equipment integrated with existing equipment, systems and facilities. The following list is by no means complete, but is intended to convey a broad view of the project.
- C. The services of a Cathodic Protection and Materials Engineering Specialist shall be used for corrosion control. Corrosion control shall include Cathodic protection as well as material selection and physical barriers such as tanking.
- D. The services of a geotechnical company shall be used in evaluating soils for foundation designs and field compliance.
- E. New systems and schemes shall generally follow the philosophy established by existing "like" systems (Systems which require interfacing) and schemes except as required by the contract documents. Alternative existing systems or schemes may be acceptable if they provide equivalent or better performance.
- F. The technical requirement of the Specification Data provides basic design parameters of major equipment and systems for the design of NOX Control nits. The Contractor shall review the supplied data and optimize unit design as necessary in order to achieve a greater performance and lowest overall cost.
- G. Drawings associated with existing facilities and equipment that interface with this contract shall be modified as required and shall comply with the following requirements:
 - Minor modifications to existing as-built drawings shall be shown on originals obtained by the Contractor from MARAFIQ files.
 - Major modifications to existing as-built drawing shall be accomplished by making new drawings to replace the existing drawing. The existing drawing numbers shall be retained.
 - New drawings shall be similar to existing "like" drawings in size, content and format. MARAFIQ drawing numbers shall be assigned in a continuation of sequence of drawing numbers for existing sub - sets into which the new drawings must be integrated.
 - 4. When the design work is finished for a particular facility or installation, the entire set of drawings, including new drawings, shall have the same organization and cohesiveness as before the design work started.
- H. The Contractor shall be responsible for research to identify MARAFIQ documents necessary to the work but not included with the contract documents. The Contractor shall also be responsible for retrieval of these documents. Reference drawings furnished with this contract shall not be considered as the total quantity of existing drawings required for the detailed design.

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SECTION – IV B (OPTION-1) INSTALLATION OF WATER INJECTION SYSTEM FOR GTG UNITS 1-8







I. TECHNICAL REQUIREMENTS

1. Contract Documents

A number of documents forming this contract (i.e. Contract Basic Form, Scope of Work, technical Speciation, General Terms and Provisions, , and drawings etc.) are correlative, complementary and mutually explanatory, and any work required in one document and not mentioned in another shall be performed to same extent and purpose as though required by all.

2. General Scope of Services

The work to be performed under this contract consists of furnishing all labor, supervision, tools, equipment, technical and professional services, materials supplies and articles necessary to perform work involving "detailed engineering design, supply, procurement, installation, testing and commissioning to established satisfactory for operating of water injection system for frame 7E GTG units # 1 to 8 on both fuels (Sales Gas and LFO)".

3. Scope of Work

The new & unified Royal Commission Environmental Regulations (2010) for Jubail and Yanbu is being implemented by Marafiq and as a general policy of the Management the Regulation is to comply with RC Regulations to control the Nox Emission from the Gas Turbine units.

The scope of work is EPC includes detailed engineering design, supply, procurement, installation, testing and commissioning to established satisfactory operation of water injection system for frame 7E GTG units # 1 to 8. Contract shall verify if the system installation is required new tank or can be utilize the existing water tank from STG plant.

The Water injection package specification given for the Reference only this unit caters for the GTG unit -9. The bidder shall provide the Centralized Water injection package to satisfy the demand of supply to GTG-1-8 simultaneously and this package includes the Storage and Distribution. The Demineralized water input shall be taken from the STG 1-4 & 5-6 Storage and Distribution network. This unit shall locate outside the GTG building, Hence the Space is the constraint. The water injection system shall include but not limited to the following:

3.1 Process Part Scope

A. On-Turbine Base

Water injection manifold, associated piping and flex hoses to carry water to the manifold. Ten tubing/flex hose
arrangements to carry water to the connection points of each of ten combustion chambers. Ten water flow
proportioning valves, one installed in each of the tubing/ flex hose lines supplying each of the combustors. A low
point drain is provided on the turbine base adjacent to the inlet connection point.

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For existing combustors, each with a set of identical water injection nozzles fed from a single connection point per combustor.

B. Off-Base (Centralized System)

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- 1. Demineralized Water Storage Tank
- 2. Inlet water strainer
- 3. Inlet water pressure switch
- High pressure centrifuge water injection pump. Motor assembly with motor space Heater.
- Variable Frequency Drive unit with pump/motor speed feedback and alarm relays.
- 6. Water pump discharge pressure transmitter
- 7. A Five micron (nominal) water filter assembly
- 8. Water filter differential pressure switch

3.2 Instrument and control Part Scope

3.2.1 SCOPE

The Contractor shall be responsible for complete engineering, design, procure, supply, factory test, delivery to site, installation, site testing, commissioning and documentation of all Control & Instrument equipments, field instruments, junction boxes, cables etc. detailed within this scope of work.

3.2.2 ENVIRONMENTAL CONDITIONS

Environmental conditions for new Demineralized water Storage Tank shall be as per site conditions defined in this scope of work document. Contractor shall design, procure, supply field instruments as per site conditions mentioned in scope of work. Contractor shall consider marine exposure to field instruments while designing selecting material of construction, enclosure material.

3.3.3 FIELD INSTRUMENTS SPECIFICATION

PURPOSE

The purpose of this specification is to define the minimum requirements of design, procure, supply, testing, calibration and supply of field instruments – Level, Pressure, local indicating instruments etc. for new Demineralized water Storage Tank at MARAFIQ, Yanbu. The Contractor shall be fully responsible for the detailed specifications for the works and production of all design documents, drawings necessary to execute the required construction work.

SCOPE

The scope of work shall include engineering, design, manufacture, testing, calibration and supply of different type of field instruments as per the standard specification. All applicable Codes & Standards adhered to the manufacture & testing applicable for field instruments shall be of the latest version as on the date of issue of enquiry and it shall be the responsibility of contractor.

The contractor shall provide necessary instrumentation as required during detailed design of the new Demineralized Water Storage Tank. This should be the minimum level of instrumentation required for the new Demineralized Water Tank.

The Proposed Demineralized Water Storage Tank shall have a similar to existing Demineralized water tanks. All necessary field instruments which are mandatory to meet or exceed the client's requirements shall be assessed during detail design stage.

All supplied field Instruments and control systems shall be as per approved MARAFIQ Vendor list. Contractor shall verify that all proposed field instruments shall be fully supported by a system support.

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organization in Saudi Arabia.

Contractor shall standardize all their instruments, transmitters, and control system. This is to obtain maximum uniformity and interchangeability.

Contractor shall provide locally field mounted instruments to indicate pressure, temperature, liquid levels etc. for maintenance, local monitoring and operation in field.

- This specification covers the design, engineering, procurement, supply of materials and equipment as applicable, labor, installation, supervision, inspection, testing and commissioning of the proposed Water Injection System for MYAS MS7001E Gas Turbines, GTG 1~8.
- 2. The MARAFIQ GTG1~8 are MKV simplex, equipped with Windows NT based HMI servers. These are divided into two functional groups each consisting of four MKV devices (GTG 1-4 and GTG 5-8). In each group the four MKV are linked by ARCNET bus utilizing ARCNET protocol for multiunit monitoring in order to control each of the four GTG by any of the four MKV HMI servers of the same group. The GT real time data is communicated to plant DCS (UCS) through MODBUS serial communication link (Mark V will be upgraded to Mark VIe.
- 3. The contractor shall furnish all necessary Instrumentation and Controls for a complete, functional, and for safe operation of the Water Injection System inclusive of on-base components, controls and off-base water forwarding skid. The work includes interconnecting cables, wires, and conduit, on base and off base, as necessary, for a complete operable water injection system.
- 4. Sufficient local instrumentation shall also be provided for maintenance and operational use.
- The work shall include implementing and configuring/programming water injection control schedule in each GT unit's Mk VIe (new system) control sequence program (CSP) to regulate the system.
- 6. The contractor shall configure the MkVle GTG 1^{~8} existing MODBUS with the newly acquired alarm/s, as necessary, in MkVle Controls and the ABB supplied DCS/UCS. The monitored signal in UCS shall be available in CCB Building 13 GTG / HRSG UCS Tenore cluster and in Building 11B UCS Tenore cluster.
- The contractor shall configure/modify, as applicable, the necessary displays, database in the MkVle HMI and the DCS/UCS GTG Cluster Tenore operator stations. For all Mark Vle modification works GE, OEM, shall be contacted and for all UCS modification works ABB Energy Automation, Italy shall be contacted.
- The work includes interconnecting cables, wires, and conduit, on base and off base, as necessary for a complete operable water injection system.
- Any equipment affected or damaged during the execution of work by the contractor and not required to be worked on according to the scope of work, shall be restored to its original condition by the contractor, at no cost to the MARAFIQ.

3.3 Mechanical Part Scope

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The work scope includes detailed engineering, design, supply, installation, testing and commissioning of the proposed installation of water injection system including piping, equipments, fittings, on-base & off-base skid complete with its piping system and all required accessories. The scope of Mechanical work of this proposal shall include but not limited to the following:

- The Scope of work for the installation of water injection system shall include the supply of materials, labor, management and supervision for the installation, testing & commissioning of complete system.
- 2. Contractor shall prepare and submit the required documentations for Marafiq approval such as schedule, engineering, design, drawings, QA/QC plan & safety plan etc.
- Contractor shall coordinate major equipment and piping layouts/ underground utilities with other trades to avoid
 obstructions and excessive changes in piping configuration. Excavation & layout will be done as per available
 underground utility.
- All tools, heavy equipment, instruments, scaffoldings and temporary works shall be provided by contractor for the construction, testing and commissioning.
- Contractor shall update the existing drawings, O&M Manuals including new equipment catalog information, settings, testing certificate, as-built drawings.
- Contractor shall prepare & submit the O&M manual, P&IDs, Piping lay out drawings, isometric drawings, mechanical drawings of equipments, shop drawings, test certificates & material specification certificates from manufacturer.

A. Mechanical Work:

Design, Supply, fabrication & installation Demineralized water storage tank, MOC of SS 316 with the capacity
of 150 M3 shall include the supply of materials, labor, management and supervision for the installation,
testing & commissioning of complete system.

Design, supply, fabrication and construction of One (1) Unit Demineralized Water Tank of 150 M¹ capacity complete with the following accessories and services:

The standards are as follows,

Standard – API 650 Material – SA 240 GR, 316

Capacity / Volume 150 m³

1.22.1 Nozzles and instrument connections

1.22.2 Manholes and access staircases

1.22.3 Platforms, handrails, stairways

Design, Supply, fabrication & installation Demineralized water inlet and distribution network piping with all
Instruments for the GTG Water injection System shall include the supply of materials, labor, management and
supervision for the installation, testing & commissioning of complete system.

Design, Supply, fabrication & Installation Demineralized water in feed pipe line to the Storage tank. The
Demineralized water after post treatment is transferred and stored from 8P-DW-T01 and 7P-DW-T01_steel
circular storage tanks each having a capacity of 3000 m3 and 1135 m3. From the 8P-DW-T01 outlet confietted.

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to Two Fixed speed pumps located near by the tank transferred Proposed Demineralized water storage tank located Nearby GTG building. In addition outlets connect to the 7P –DW-T01 Demineralized Pump – 7P-DW-P01 A/B outlet shall also connected to the Demineralized water line from 8P-DW-T01.

- 4. Design, Supply, fabrication & installation of water injection pumps skid mounted with all accessories, equipments & fittings inside the GTG building as shown on the reference drawing # 00004-ME-A3-217.
- Design, Supply, fabrication & installation of pumps suction lines including valves, suction strainer, tie-in with source of demineralized water including installation of Demineralized water transfer pumps as shown on the reference drawing # 00004-ME-A3-217.
- Design, Supply, fabrication & installation of pumps discharge lines including valves, control valve, fittings, supply manifold in turbine enclosure including a low point drain on the turbine base adjacent to the inlet connection point. Pipe shown on the reference drawing # L6966-ME-A1-1017.
- 7. Design, Supply, fabrication & installation of ten tubing/flex hose arrangements to carry water to the connection points of each of ten combustion chambers. Ten water flow proportioning valves; one installed in each of the tubing/ flex hose lines supplying each of the combustors. Such that; ten separate combustors, each with a sec of identical water injection nozzles fed from a single connection point per combustor.

4.7 Piping and Tie-ins

The piping and tie-ins shall be as shown on the drawings listed below,

1. Drawing # 00004-ME-A3-217,

Title: GTG Water Injection System Schema (20.801/1921)

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4.8 Changeover / Connection

The inlet line from the proposed Demineralized water tank shall be routed as the redundant supply header to the existing Demineralized water pumps 7P-DW-P-01 !/B, with all the necessary valves, fittings and connections.

4.9 Piping Works

The scope of work shall incorporate the following requirements:

1. <u>Demineralized Water Storage Tank Piping System:</u>

Design, supply of materials, labour, equipment, supervision for the installation, testing and inspection of Demineralized water inlet and outlet pipeline of the tank, Demineralized line for plant supply / use, required valves and accessories.

The major element of piping works includes but not limited to the following:

- The proposed DM tank shall have One (1) externally connected inlet pipelines to the tank shell thru which it shall receive Demineralized water. From 7P-DW-T01 & 8P-DW-T01.
- 2. The contractor shall be responsible for making the physical connection at all required interface tie-in points and testing of the system for all piping, isolation up to the interface location with the existing tie-ins.
- The tank's inlet valves (Pneumatic Control Valve) with all accessories shall be installed above ground on externally connected inlet line to the tank shell complete with drain lines.

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- Provide mechanical joint connector and expansion joint as required at the tank's inlet isolation valve.
- The tank outlet valves with all accessories on the tank's outlet line (manual) shall be installed above ground.
- 6. The proposed outlet pipeline, 250 mm diameter complete with tee for future connection, from the proposed DM Tank.
- Supply and install the required gate valve and air vent at the highest point of the proposed Demineralized water outlet pipeline.
- Paint all piping and supports. Piping shall be painted with the color coding as per MARAFIQ standards.
- All newly installed piping shall be hydro-tested to 1.5 times the design pressure.
- 10. Any system affected by the modification shall be reconnected including Cathodic Protection.
- Contractor shall ensure in the submitted design that newly installed inlet and outlet pipe lines shall not cause any adverse or pressure situation in the existing pipelines at tie-ins and/or otherwise.

B. Testing & Commissioning:

- Contractor shall repair and restore the system to its original form all utilities affected by this modification work.
- Contractor shall housekeeping & shall restore work area. Dispose debris, scraps and surplus material to the designated disposal area.
- 3. Start the commissioning activities as per instructions of OEM.

C. Material Specification and Installation Requirements

	Centrifugal pumps	
	Foot mounted radial split single volute type casing	
	NPSH/ Diff Head: VTS	
	No. of Pumps: 02 Nos.	
	Speed:	
Demineralized	Flow capacity: 70m³/hr	
Water Transfer	Casing/ Impeller material: API Class A8; AISi304	
Pumps	Suction/ Discharge: class 150RF connection	
	Service Medium: Demineralized water	
	Centrifugal pumps	CTRC WITE INC
	D. Head: VTS .	CTRIC WITT INC SELECTION S
	Flow capacity: 35m³/hr	
Water Injection	No. of Pumps: 03 Nos.(2W+15)	וועריין (פון אוויין פון אוויין פון אוויין פון אוויין ווויין פון אוויין ווויין פון אוויין ווויין פון אוויין ווויין
Pumps	Service Medium: Demineralized water	
	Variable frequency drive-VFD motor	0223377 1-1-YYYYYY 21-3
	Stainless steel seamless pipe	
	Size: DN75/100, Schedule-40,	
Piping Specifications	Material: SS, EFW, ASTM A 312-TP 316/316L.	1 solution
	Material specification Line Class: 1SD0B03	MARAFIO



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	Design Code: ASME B31.3	
Flanges	Slip-on type, RF (Raised Face Flanges)	
	Size: DN75/100, Class 150	
	Material: SS, ASTM A182-F316/316L,	
	Design Code: ASME B16.5	
Fittings	Fittings including	
	Elbow 90° LR, Reducer (CONC), nipples & sockets etc.	
	Material: SS, ASTM A403-WP 316/316L-W,	
	Design Code: ASME B16.9	
Valves	Gate valves	
	Class-150, RF	
	Material: 316 SS body w/316 trim, FP	
Bolts/ Nuts	Bolts/ Studs; ASTM A193, Gr B 7 stud	
	Heavy hex Nuts; ASTM A194, GR 2H	
Gaskets	Class: 150, 1/16" thick	
	Flexible graphite w/316SS corrugated insert	
	Design Code: ASME B 16.21	

D. Testing and inspection

The contractor shall fully test /commission the water injection system and shall demonstrate full functionality to MARAFIQ prior to work acceptance.

All testing shall be scheduled in advance to allow sufficient time for advising Marafiq representatives to witness the test.

E. Submittals

The drawings and documents shall include submittals of design drawings, shop drawings, as-built drawings, and manufacturer's engineering and other miscellaneous documents, including but not limited to:

- 1. Instruments layout plans and installation detail drawings
- 2. Instruments installation details
- 3. Instruments Specification Sheets
- 4. Installation and interface wiring diagrams
- 5. As-Built drawings reflecting all changes based on construction variations.
- 6. Control system Ladder/Logic diagrams
- 7. Piping and Instrument diagrams
- 8. Instrument Loop diagrams
- 9. Water Injection Skid Arrangement and Control Panel Drawings
- 10. Wiring diagram
- 11. External Interconnection Diagram
- 12. Instrument List
- 13. Control Logic Drawings
- 14. Control System Description
- 15. Instrument Plan and Location Drawings
- 16. Instrument Installation Drawings
- 17. Instrumentation grounding plan and details





- 18. Instrument Equipment Specification submittals
- 19. This shall include all of the equipment specifications required for this contract.
- Instrument calibration procedure and loop test procedure.

3.4 Civil part scope

The work scope includes detailed engineering, design, supply, installation, testing and commissioning of the proposed installation of water injection system including civil work, on-base & off-base skid foundation and tank foundation if required etc. complete with its piping support system and all required accessories. The scope of civil work of this proposal shall include but not limited to the following:

- The Scope of work for the installation of water injection system shall include the supply of materials, labor, management and supervision for the installation, testing & commissioning of complete system.
- 2. Contractor shall prepare and submit the required documentations for Marafiq approval such as schedule, engineering, design, drawings, QA/QC plan & safety plan etc.
- Excavation & layout will be done as per available underground utility.
- 4. All tools, equipment, instruments, scaffoldings and temporary works shall be provided by contractor for the construction, testing and commissioning.
- Contractor shall update the existing drawings, O&M Manuals including new equipment catalog information, settings, testing certificate, as-built drawings.
- 6. Contractor shall prepare & submit the O&M manual, piping lay out drawings.

Civil Work:

- The Contractor shall design and construct structures for tank foundation, pipe supports, valve pits, manholes, thrust blocks (if required), encasements, etc
- The Contractor shall design and construct structures for Pump foundation, pipe supports, etc
- The Contractor shall design and construct drains interconnected to existing storm water drainage. Surrounding
 area around tank foundation's perimeter shall be sloped towards existing ditches for proper drainage of any runoff
 water.
- 4. Civil work shall include but is not limited to excavation, dewatering, backfilling, disposal of excess or unsuitable materials, site grading, compaction, vapour barrier, blinding concrete, concrete foundations, encasements, sleeves, steel supports, and other related fixtures and testing.
- 5. The Contractor shall install a circumferential boundary guard rail of one metre height above the finish ground level as per RC standard drawing # RC-C-12.
- All exterior surfaces of concrete structure below finish grade shall be protected by waterproofing membrane with 12mm thick protection board. Exposed concrete surfaces shall be coated with an approved damp proof coating.
- It shall be the Contractor's responsibility to locate and protect all underground and exposed structures near the project perimeter.
- 8. The Contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utility which obstructs the execution of the contractor shall relocate any utilities and the contractor shall

3.5 Electrical Part Scope

A. Electrical works

The scope of work under this contract includes engineering, design, supply, installation, testing and commissioning of complete electrical systems and equipments required for the successful completion

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of the project. The basic electrical materials and installation shall be as per submitted RC guide specification, Section 16050, "Basic Materials and Methods – Electrical".

This include the following and any other items, components, units, parts and efforts which may or may not be specifically mentioned in this scope but may be required for the satisfactory & successful commissioning & operation of the project.

All electrical equipments shall be designed for 50°C maximum ambient, 40°C average ambient (24 Hr) and shall be tropical zed for protection against humidity, saline atmosphere and ingress of dust.

- Design, Supply installation, termination, testing and commissioning of outgoing Power and Control Cables up to the disconnect switches, cathodic protection System, conduits, junction boxes etc with all required supports as per approved design drawings.
- Design, supply and installation of power supply conduits, supports and accessories for all electrical equipments such as Cathodic Protection system, and field instruments etc. as per approved design drawings.
- Design, Supply installation, termination, testing and commissioning of Power and Control Cables from Existing 480V MCC located in Building no-11A & DM Water Pump House from STG 5 & 6.
- 4. Design, Supply and Construction of Underground Electrical Duct bank.
- Design, Supply and installation of the Grounding system.
- Provide all necessary electrical design drawings and calculations.
- **b.** Design the size of the motor, cable, motor starter, including over load relay for protection for the system in all GTGs Units # 1 to 8.
- c. Supply and install a remote control station (Push button station) near new location of Pump.
- d. The power supply to pump motor is to be taken from available spare feeder of 480V MCC panel in GTG Building. Power and control cable of pumps motors is to be laid through suitable size of metallic conduct with convenient route. PVC conduct is used for underground cable laying and hot dip galvanized metallic conduct is used for cable laying on or above ground level. All conduit runs shall comply with the requirements of Table 346-10 of the MYAS ELECTRICAL CODE for either factory bends or field made bends.
- e. All the motors and push button stations is connected to grounding and bonding.
- f. Supply and install the power cable and control cable, and grounding cable to new pump motors.
- g. Supply and install all necessary underground PVC conduits, hot dip galvanized metallic conduct for cables laying.
- h. Supply and install grounding cable for pump-motor and control station. Equipment grounding connections and connections integration in existing plant grounding grid.
- i. Testing and commissioning of electrical equipment installed for proper functioning.
- j. Updating the existing drawings and as built installation Drawings. Operation and Maintenance manuals including new equipment catalog information, settings, testing certificate, as built drawings.
- B Installation and Material Specification Requirements

1. POWER SUPPLY TO PUMPS FROM BLDG NO. – 11A & DM Water Pump House STG 5 & 6







- The power supply for new pumps shall be obtained from spare cubicles in existing 480V, 3Ph, 60 Hz MCC in Building No. 11A & DM Water Pump House from STG 5 & 6. The existing spare cubicles of MCC shall be retrofitted to make it suitable for supplying power to the pumps.
- Contractor shall supply and install cables having copper conductor, XLPE insulation & PVC jacket with all associated accessories for supplying power to the Pumps. The cable routing shall be decided by the contractor and all work required for the routing of the cable is includes in the Contractor's scope.
- 3. The Contractor shall install suitable Impressed Current Cathodic protection to protect the tank from corrosion with Local Control Monitoring Panel.
- 4. All electrical work required for proper functioning of the pumps is included in the Contractor's scope.
- 5. Optional 480V MCC
 - a. In case there are no spare cubicles in existing MCC, then the Contractor shall provide and install one (1) No. new 480V, 3 Ph. 60 Hz. MCC to be located in existing Building No.11A & DM Water Pump House from STG 5 & 6.
 - b. Contractor shall provide and install a new circuit breaker as retrofit to the existing switchgear cubicle. The scope of work also include supply and installation of feeder cable from the new circuit breaker from the Existing MCC, terminations, conduits, cable trays, and any civil works as required to install and connect the MCC including testing and commissioning
 - c. The new MCC shall be draw-out type 600 V class suitable for operation on 480 V, 3 phase, 3 wire 60 Hz system in NEMA 12 enclosure.
 - d. The MCC shall comply with the RC Guide Specification Section 16155-Motor starters and 480 V Motor Control center.
 - e. The MCC shall have minimum three spare feeder circuit breakers and space for two size 2 combination starter units.

B <u>Testing After Installation</u>

All site work and equipment installation shall be inspected and tested by the contractor in accordance with Marafiq approved Inspection & Test Procedures and witnessed by Marafiq representative.

The inspection shall include but not limited to the following;

- The installation of power cables, conducts.
- Grounding and bonding of Electrical equipment's.
- Physical check of all electrical termination and other fasteners to ensure quality of work.
- Verify the performance of each equipment and feeders.
- Insulation resistance of electrical equipment.

Upon completion of testing, submit certified reports attesting that each test was performed in accordance with approved test procedures.

Engineering and design responsibilities

1. The required installation of the water injection shall include review the complete design, development, the final as-built drawings and other required documents.

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- The engineering and design responsibilities, under this contract, shall include obtaining, research, and applying design information on relevant existing systems design documents/drawings by utilizing technical documents from the Owner's files.
- 3. The Nox. test result must be compliance with RC limit at the worst cause

3.6 Cathodic Protection System

Scope of Works

This specification covers the design, material, construction, testing and performance of the impressedcurrent type Cathodic Protection systems for the Demineralized Water tank.

- Cathodic protection system in plant facilities may include but not limited to following structures.
 - 1. Exterior surfaces of the storage tank bottom
 - 2. Reinforced concrete structures
 - Underground metallic structures from corrosion.
- 2. Monitoring and control system of the Cathodic Protection system shall interface with the existing monitoring & control system.

2. Design Requirements

- The design, fabrication, testing, and performance of the cathodic protection system shall be in accordance with the latest edition of the standards, codes and latest edition of API-651 refereed in RC Guide line Specifications.
- 2. The Cathodic Protection system shall be as per attached RC Guide line Spec.
 - 1. Section 16648 Impressed Current Cathodic Protection for On-Grade Storage Tank Bottom.
 - 2. Section 16645 Impressed Current Cathodic Protection of reinforced concrete structures.
 - 3. Section16647 Corrosion Control of Underground Metallic Structures
- 3. The Contractor shall employ a Cathodic Protection Consultant for design, installation, energization, and commissioning of Cathodic Protection system (for Tank bottom, concrete ring wall and appurtenances) in accordance with above RC Guideline Specifications and the latest edition of API
- 4. The CP system shall be designed ,installed and commissioned to meet the operational criteria as identified in NACE RPO193-93.External Cathodic Protection of on –Grade storage bottom tank.
- 5. The Anode system shall provide protection against corrosion for a minimum of 40 Years.
- 6. Contractor shall be required to make a site visit to perform the following:

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to perform the following: אָנּדּוֹשׁהֹעִינִים װִשׁפָּוּנָּ איז PROCUREMENT & CONTRACTS DEPT

- 1. The soil resistivity measurements
- 2. The corrosivity estimation
- A special study of stray current interference

In order to collect data for cathodic protection design calculations and select suitable locations and method for installing anode groundbeds and rectifiers.

3. Installation and material Specification Requirements

- The material specification for various products such as listed below shall be as per RC guide line spec.section-16648 Power supply system (T/R), Power supply system control configuration-Remote Monitoring unit, Local Rectifier unit, Control software, Anode system, Reference Electrodes, DC & Instrumentation Cabling, Junction boxes etc.
- Installation, Testing & Commissioning of the CP system, Submittal, training of Engineer etc shall be as per RC guide line spec.
- The CP system shall be installed for the following:



1. For ground Storage Tanks:

As a minimum requirement, the sub-base beneath the Tank floor is made up of a 500 mm thick layer of compacted gravel fill. A 50 mm thick sand bed will cover the gravel and act to protect a 500 Micron polyethylene liner. Between the liner and the Tank bottom an impressed current anode system is installed in a 300 mm thick layer of clean dry sand. A duct will be provided in the ring wall for Instrumentation & electrical connections as required.

For all underground Metallic Structure:

Contractor shall ensure that all underground metallic structure shall be protected by CP system:

- 1. Tank discharge nozzle/Valve pit
- 2. Thrust Block and Tank underground pipe

3.7 Installation & construction

The contractor shall be responsible for performing a complete installation, testing and commissioning the water injection system, as specified, conforming to the MARAFIQ approved Scope of Work, professional standards of skill; performing work of a similar nature. Unless otherwise expressly provided herein, all materials and equipment shall be new and shall conform to the specifications, drawings, samples and other descriptions set forth in this contract or provided by contractor and approved by MARAFIQ

3.8 Recommended spare parts list

The contractor shall submit recommended spare parts list (RSPL) for the water injection system and its auxiliaries. The contractor shall promptly update and resubmit the RSPL, as necessary, in accordance with the equipment approval.

PROCUREMENT &

3.9 Site acceptance test (SAT)



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MARAFIQ shall have the right to witness at any time any test performed hereunder by Contractor or its vendors or Subcontractors, and Contractor shall give MARAFIQ reasonable advance notice of any such test in accordance with MARAFIQ requirements.

The SAT, Site Acceptance shall be in accordance with accepted International Standards. SAT procedures shall be complete unto themselves. A full set of function simulation test for the all equipment with response checking shall be included. As a minimum, the following information shall be included in the SAT procedures:

- a) Description of test procedures required.
- b) Description of any supplemental test hardware or software required.
- c) Description of system response verifying the completion of each step.
- d) Recording results of test sheets, with time, date and MARAFIQ's sign-off.
- e) The Site acceptance test shall include but not limited to testing of Water
- f) injection Equipments, controls and Base/Peak Load performance with
- g) Existing Mark VIe, and UCS system, displays, alarms and events.

3.10 Inspection and testing

- MARAFIQ reserves the right to witness all of testing and inspection activities per approved plan. Test
 records shall be submitted for the entire system.
- The contractor shall carry out all on-Site inspection and testing of the entire system under the scope of supply. The MARAFIQ shall have the right to reject any part of the work reasonably found unsatisfactory or not acceptable on the basis of results of such inspection and testing.
- Marafiq is requested NOx emissions level below 84 ppmvd @15% O2 on Natural Gas fuel with a singlenozzle combustion system is possible with optimum water injection rate.
- 4. Water purity is essential for wet injection systems in order to prevent erosion and/or the formation of deposits in the hot sections of the gas turbine. Water quality specifications need to be specified by water injection system's supplier.
- Exhausted through a single HRSG shall be compliance with RC regulations NOX Emission.
- 6. It should be noted that the maximum and minimum flow limits and flow cutoff at low fuel flow shall be adjustable to enable compliance with NOx emission requirements and further to prevent excessive invention of water into the combustion chambers of the gas turbine which may cause flame out.
- 7. For Marafiq configuration where two gas turbine are exhausted one through the exhaust bypass stack and other one through the heat recovery steam generating unit, contractor must to test and measure both the emissions at the bypass stack and the exhaust stack for the heat recovery steam generating unit and the fuel flow to each combustion turbine at same fuel flow and load.
- 8. The water injection system shall be adopted to work with GE Mark VIe and UCS for the GTG units.
- 9. Contractors is requested to provide the following data:
 - Uncontrolled no emission factors and the ranges of Nox emissions for gas turbine frame 7001E on both specified fuels (Sales Gas and LFO).
 - Influence of firing temperature on thermal Nox formation on both fuel (Sales Gas and LFO).
 - Uncontrolled Nox emission levels and gas turbine manufacturer guaranteed controlled levels using water injection with sales gas and LFO
 - The contractor shall give at least one (1) week advance notice to MARAFIQ to witness any of the on-site test and inspection activities per approved schedule.
 - The contractor shall report to and work to the schedule requirements of the contract and MARAFIQ work times.

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3.11 Reference Drawing

Serial Number	Drawing Number	Description
1	ME-A1-1017	GTG Water Injection System (GTG-9)
2	00004-ME-A3-217	GTG Water Injection System Schematic Diagram (Proposed)





SECTION – IV B (OPTION-2) INSTALLATION OF DLN-1 SYSTEM FOR GTG UNITS 1-8







1. General scope of services

MARAFIQ intends to go for GTG frame 7001E emission control technologies, since all Gas Turbine Generator's rotors have reached to 200K.

The work to be performed under this contract consists of furnishing all labor, supervision, tools, equipment, technical and professional services, materials supplies and articles necessary to perform work involving "is to replacement of DLN -1 for controlling the NOX Level".

2. Engineering and design responsibilities

- a) The required professional Replacement shall include review the complete design, development, the final asbuilt drawings and other required documents necessary and related professional services in connection with the as specified herein, except as may be specifically excluded in the contract document.
- b) The engineering and design responsibilities, under this contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/ drawings by utilizing technical documents from the Owner's files.

3. Applicable codes and standards

- a) The contractor shall comply with the applicable parts of the following industry codes & standards as basis for all types of engineering & construction works.
- b) American Petroleum Institute API-616 for Gas Turbine.
- c) American National Standards Institute (ANSI)
- d) American Society for Testing and Materials (ASTM)
- e) Saudi Arabian Standards Organization (SASO)

4. TECHNICAL REQUIREMENTS OF DLN-1

4.1 Proposed Modification

Marafiq is considering DLN-1 system for Control Emission in Turbine modification as a package for each Gas Turbine Generators (for GTG 1 to 8) to achieve the higher reliability achieved through advanced technology. The existing 56.2 MW Gas Turbine Generators Frame 7001E (for GTG 1 to 8) is Hitachi Manufactured, licensed from GE. The results of replacement should serve as a basis to predict the Life Time expectancy of the Frame-7001E Gas Turbines Compressor and Turbine.

4.2 DRY LOW NOX - 1 (DLN-1)

The DLN system Scope of Supply is limited to the following:

- 1. DLN 1 Conversion (Dual Fuel)
- 2. Controls modification for DLN 1 Dual fuel unit
- 3. Design & Engineering charges DLN 1
- 4. IR Hazardous Gas Protection System
- 5. Laser Scan for DLN modification







DLN combustion system is a Pre-Mix combustion system, which reduces NOx through lean premixed burning in multi-zone combustion liners, and by new fuel control equipment which directs fuel to the different liner zones depending on the mode of operation. Flame becomes cooler due to the extra mass of the air, and as such, produces less NOx. NOx control for gas fuel is via the Dry Low NOx-I system, while NOx control for distillate fuel oil is by lean combustion augmented with an optional water injection system. It is expected that the DLN1 system will reduce NOx emissions to 25 ppmvd on natural gas operation and Less than 80 ppmvd on Distillate.

The proposed 71E DLN-1 uprate has the following features:

- Replacement installed combustion system with Dry Low NOx combustion
- ☑ New Fuel gas valve module and piping: The fuel system will be replaced with an off-base fuel valve module connected to on-base fuel manifolds. Purge air is provided to the transfer fuel manifold during normal premix operation.
- Site Survey with Laser Scan
- ☑ Controls Modifications hardware uprates required are not included in this proposal
- Hazardous Gas Protection System

Operation of DLN 1 system at part load shall be applicable.

4.3 CONTROL SYSTEM

Steam Injection and DLN 1 control will accommodate the additional I/O capability Mark Vie for all the Units

4.4 PERFORMANCE EFFECT

Amb.Temp	Std, No Injection		DLN			
deg.F	Output,%	Heat rate,%	Inj Rate	Output,%	Heat rate,%	Inj Rate
45	Base Case		0	-0.83	0.49	0.00
65			0	-0.85	0.52	0.00
85			0	-0.90	0.56	0.00
105			0	-1.08	0.63	0.00
122			0	-1.31	0.71	0.00



4.5 Inspection and testing

Except GTG-3, MARAFIQ shall have the right to reject any part of the work reasonably found to be unsatisfactory or not acceptable on the basis of results of such inspection and testing.

4.6 Acceptance Criteria

Operation and test run of each GTG's with ensure the each Gas Turbine Generators (for GTG 1 to 8) to Improve Heat Rate & Assurance with supporting evidence for the higher reliability achieved through advanced technology.

- The vendor shall provide the Best Technology to Control the Nox Emissions below 80 ppm as per RC
 Environmental regulatory and Nox performance must be guaranteed from 0 till Peak Load to maintain Nox < 80
 ppm from Bypass Stack and HRSG Stack.
- 2. The Nox Control Technology shall be selected in between Water Injection and Dry Low Nox.





- 3. Exhaust Temperature to HRSG shall not exceed 590 °C at Peak Load to protect the Gas Turbine Downstream Equipments from any thermal stress.
- 4. By using uprated material, Cooling System, IGV and sealing system Generator output shall be increased as per OEM mentioned on the uprate proposal and study shall be made to confirm no any effect on the Generator Winding and no increase on the exhaust temperature beyond 590 °C.
- 5. By using Nox Control, Uprated Material, Cooling System, IGV and Sealing System we should eliminate the one CI at 8000 FFH in between MI and HGPI.







SECTION – IV C UPGRADE OF SPEED TRONIC FROM MARK V TO MARK Vie FOR GTG UNITS 1-9





I. TECHNICAL DATA

Technical Data of Gas Turbines

Parameter	Unit	GT-1-8	GT-9
Commissioning Year		1982	1999
Useful life	Years	25	
Manufacturer		Hitachi	General Electric
Output	MW	60	68

Technical Data of HRSG

Parameter	Unit	HRSG-1-4	HRSG-6	
Commissioning Yr		1982	1999	
Design life	Years	25		
Manufacturer		Mitsubishi	NEM (Mecanica de le Pena SA)	

Parameter		Unit	HRSG-1-4	HRSG-5
Serial number(s)		no.	H-253, H-354, H-355, H-356	3596
Туре			Horizontal	
Design	Pressure	bar	10.6	10.6
	Temperature	°C	186	186
Design capacity		t/h	159	172

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II. General Information

1. GTG 1 to 8 Control System

The control systems of the gas turbine consist of gas-turbine mounted component assemblies and devices, the turbine electric control panel and the control cabinet, and the interconnecting cable between the gas turbine and the control cabinet. Within the turbine electric control panel is the Mark V SPEEDTRONIC simplex control panel. The SPEEDTRONIC™ is a microprocessor based control system which provides the analog and digital signals to control and protect the operation of the gas turbine.

Gas turbine generator controls are housed in an air conditioned control environment compartment. The cabling in which off base and on base devices of gas turbine generators are done through field junction boxes and I/O modules provided within Mark V cabinet. The control architecture employ for Gas 1 Turbine is by means of HMI and simplex SPEEDTRONICTM Mark V control. The Mark V panel is a standalone system housed in a NEMA 12 enclosure with lower ventilation to allow sufficient air re-circulation. Mark V provides monitoring and control of entire gas turbine start-up and shutdown, on base and off base process instrumentation, permissive and trip related to its corresponding HRSG damper operation. The HMI has all the access to operate GTG locally. All data related for alarm management and GTG discrete controls are both hardwired and via MODBUS link to the UCS system. The other remote control functions for the GTG's is from LCR building 11B or CCR building 13 UCS TENORE OIU's. In the event that HMI and UCS are both shutdowns and disabled by any means, the back-up operator interface unit installed within Mark V cabinet can initiate GTG's start-up and shutdown to a minimum acceptable GTG operation.

GTG 1 to 8 SPEEDTRONIC™ Mark V control is simplex in architecture in which only single processor <R> handles and processes all control logics and protection of Gas Turbine. Mark V receives signals (i.e, speed, temperature etc.) to compute the required or permissible values of fuel input to gas turbine for start-up, synchronizing, operation and loading of gas turbine into generator.

SPEEDTRONIC[™] Mark V Simplex unit control system consists of various loops such as start up control, speed control and temperature control. The derived outputs of these loops are integrated into final fuel and control logic of gas turbine which limits the amount of fuel.

Operating conditions of the turbine are sensed and utilized as feedback signals to the SPEEDTRONIC control system. There are three major control loops — start-up, speed and temperature, which may be in control during turbine operation. These loops command Fuel Stroke Reference (FSR), the command signal for fuel. The outputs of these control loops are connected to a minimum value select algorithm.

The minimum value select algorithm selects the lowest FSR called for by the control loops and passes the result to the FSR controller. The action of this circuit is similar to a low-voltage selector. The lowest voltage output of the control loops is allowed to pass the gate to the fuel control system as the controlling FSR voltage. Fuel Stroke Reference (FSR) is the command signal for the fuel. Using this method of FSR selection, switching between the controls modes of speed, temperature and start-up control takes place without any discontinuity. The controlling FSR will establish the fuel input to the turbine at the value required by the system which is in control. Displays on the turbine control panel CRT indicate which of the control systems is controlling FSR.







2. GTG 1 to 8 MARK V Simplex Control System Description

For the Gas Turbine Generator (GTG) 1 – 8, a GE SPEEDTRONICTM Mark V Simplex Turbine Control System was supplied in YANPET Infrastructure Expansion Project, Package C-004.

The Simplex control system offers state of the art electronic technology, increased reliability and availability, user friendly operator control, and dramatically improved troubleshooting and maintenance capability. Even as a single channel control, the Mark V Simplex emergency over speed protection system includes triple redundant processors for maximum protection against damaging over speed conditions.

The Mark V Simplex Gas Turbine Control is a single channel control system for the GTG 1-8, and it is compatible with fuel regulator controlled turbines.

Application software for control and protection algorithms which are used on new GTG 1 to 8 are similar that are used in GE gas turbines.

With the Mark V control system, a direct interface is provided for all turbine sensors and actuators. This eliminates interposing instrumentation, such as vibration systems, and the associated failure points associated with interposing electronics. Diagnostics are able to directly monitor vibrations sensors, whether they are seismic type or Bentley Nevada Proximitors R. Bentley Nevada Proximitors are monitored for vibration protection, thrust wear protection, differential expansion and eccentricity. In addition, the system provides monitoring of thermocouples and RTD's.

One set of redundant magnetic speed pickups are accommodated to insure maximum turbine availability. The set of speed pickups feed the controller which provides speed control and the primary over speed protection from the elaborated speed signal. Standard on-line and off-line over speed tests are provided for the over speed system.

Advanced diagnostics are provided including a sequence of events (SOE) log: this eliminates the need for separate SOE instrumentation and the need for multiple field contacts to trip the turbine and to trigger the traditional SOE. On-line diagnostics continuously checks the controller, and any abnormal condition in the logical or analog control is alarmed with a time tagged message on the CRT and on the printer.

An industrial grade PC is provided for the operator / maintenance interface referred as HMI. It can be used for all operator commands and monitoring or as a local maintenance interface with all operator control from the central plant distributed control system (DCS) via an RS232 communication link. Application software is displayed in ladder diagram format on the CRT. Application software can be edited while the turbine is running including I/O assignments, sequencing, control, protection, tuning constants and displays. Software changes are password protected and stored in EEPROM in the controllers. Revised software documentation is provided on the printer with cross references, settings of tuning constants and written descriptions of software names.

3. Architecture

The Mark V turbine control is a dedicated control system which provides direct interface from the cards in the controllers to the sensors and actuators on the turbine. This eliminates single point failures, reduces long term maintenance and facilitates advanced diagnostics by allowing the cards to directly monitor the sensors and actuators.

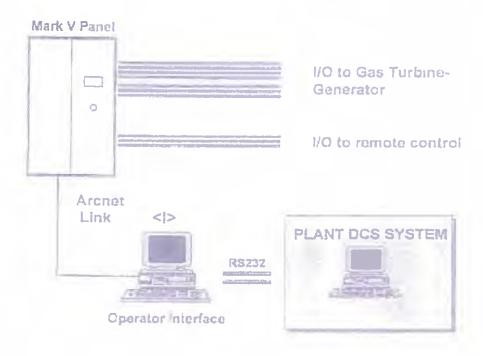
The primary controller <R> in the Mark V Simplex contains all control and most trip protection software and hardware. I/O such as speed inputs, valve interface, etc. interfaces with the <R> controller.

The <P> Protective controller contains three sets of identical cards "X", "Y", "Z" which have their own power supplies and their own processor. Their controllers provide control and interface for flame detection and emergency over speed protection for turbines.

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 The <C> controller is used for non-control and non-trip I/O interfaces, and it provides communication to the Operator / Maintenance interface <I>. All operator commands and monitoring can be performed from this interface, and all maintenance functions can be performed including changing control constants, editing application software, changing I/O assignments and editing displays. The <I> Interface (HMI's) is an industrial grade PC which is located locally (GTG shelters, PEEC BLDG.) and are configured to interface with the eight Mark V turbine controls and their associated control systems. Communication links are available from the <I> to remote computers (DCS/UCS) to perform remote control and monitoring of the Mark V. All operator commands which can be performed locally at the <I> can be performed remotely via the communication link, and all Mark V data can be monitored by the remote computer (DCS/UCS).

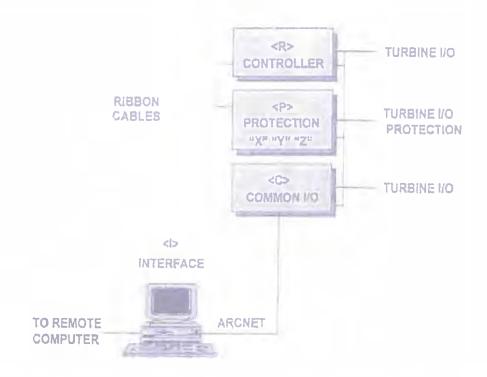
Mark V Simplex Control System











4. GTG 9 MARK V TMR Control System Description

GTG 9 SPEEDTRONIC™ Mark V TMR control was supplied under contract RCL-I-6966, TPL. It was integrated in package C-004 along with other GTG's 1 to 8 SPEEDTRONIC™ Simplex MARKV.

Recently in 2010, GTG 9 < > interface was replaced by two number HMI's.

At the core of SPEEDTRONIC™ Mark V TMR control are the three identical control processors called <R> <S> and <T>.

All critical control algorithms, turbine sequencing and primary protective functions are handled by these processors. They also gather data and generate most of the alarms. The three control processors accept input from various arrangements of redundant turbine and generator sensors.

Some sensors are brought in to all three control processors, but many, like exhaust thermocouples, are divided among the control processors. The individual exhaust temperature measurements are exchanged on the voter link so that each control processor knows all exhaust thermocouple values. Voted sensor values are computed by each of the control processors. These voted values are used in control and sequencing algorithms that produce the required control actions. One key output goes to the servo valves used in position loops. These position loops are closed digitally. Redundant LVDTs (Linear Variable Differential Transformers, a position sensor) produce a signal proportional to actuator position. Each control processor measures both LVDT signals and chooses the higher of the two signals. This value is chosen because the LVDT is designed to have a strong failure preference for low voltage output. The signal is compared with the position command and the error signal passed through a transfer function and a D/A converter to a current amplifier. The current amplifier from each control processor drives one of the three coils. The servo valve acts on the sum of the ampere turns. If one of the three channels fails, the maximum current that one failed amplifier can deliver is overridden by the combined signals from the remaining two good amplifiers. The result is that the turbine continues running under control.

An independent protective module <P> is internally tripled redundant. It accepts speed sensors, flame detectors and potential transformer inputs to perform emergency electronic over speed, flame detection and synchronizing functions. Hardware voting for <P> solenoid outputs is accomplished on a trip card associated with the module. The





trip card merges trip contact signals from the emergency over speed, the main control processors, manual trip push buttons and other hardwired customer trips.

Over speed and synchronization functions are independently performed in both the triple redundant control and triple-redundant protective hardware, which reduces the probability of machine over speed or out of phase synchronizing to the lowest achievable values.

SPEEDTRONICTM Mark V control provides interfaces to DCS systems for plant control from the <I> processor. The two interfaces available are Modbus Slave Station and a standard Ethernet link, which complies with the IEEE-802.3 specification for the physical and medium access control (MAC) layers. A GE protocol is available for use over the Ethernet link.

5. Existing GTG 1 to 8 HMI descriptions:

The MYAS GTG1~8 are MKV simplex equipped with Windows NT based HMI servers. These are divided into two functional groups each consisting of four MKV devices (GTG 1-4 and GTG 5-8). In each group the four MKV are linked by ARCNET bus utilizing ARCNET protocol for multiunit monitoring in order to control each of the four GTG by any of the four MKV HMI servers of the same group. The GTG-9 presently is by function not part of these groupings.

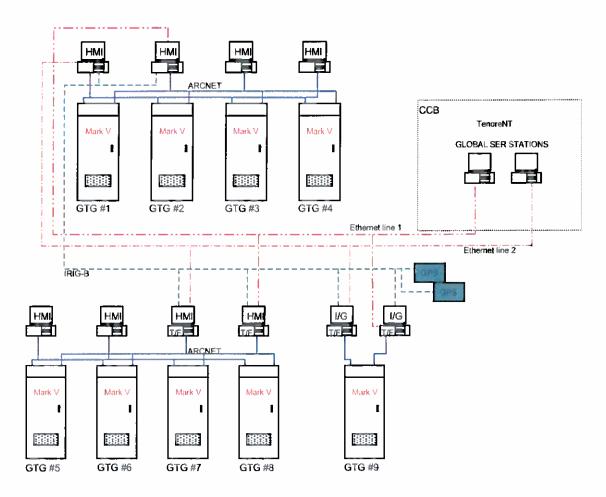
Presently the GTG1 to 8 MKV HMI work stations are installed in the unit local shelter (PEEC) and is interfaced with the plant-wide DCS based Unified Control system (UCS) via redundant RS-232-C Serial Links (MODBUS protocol) for unit remote monitoring and control from both the Local and the Central Control Rooms. The GTG-1 to 8 MKV critical Sequence of Event (SOE) data is transmitted to the UCS Global Sequence of Event Recorder (SER) TENORE server in the CCR via the Ethernet-TCP/IP apart from unit data transmission to the UCS via MODBUS.







6. Topologic arrangement of GTG 1 to 8 and GTG9 with global server



The Mark V HMI system is the local Operator Interface Unit for control and monitoring. One Mark V HMI is installed in each Control Compartment. The Mark V and HMI of units1 to 4 are connected all together through the ARCNET bus. The same connection is provided for units 5 to 8.

Each Mark V HMI is be configured with multi-unit monitoring in order to control four GTG (group 1-4 or group 5-8). This means, for example, that using the HMI of unit 2 it is possible to control the GTG unit 1, 2, 3 and 4.

Moreover each Mark V HMI has two MODBUS communication links to UCS: the first one dedicated to the corresponding GTG, the second one to the adjacent GTG. In such a way each Mark V has redundant MODBUS connection to UCS: one line through the HMI of that unit, the other line through the adjacent unit HMI.

The Mark V HMI installed in GTG#1, 2, 7 and 8 Control Compartment have also a GSM protocol (TCP-IP) to transmit SOE data and a T/F card in order to be synchronized by a GPS receiver.

The HMI of GTG#1 and #2 transmit SOE data of the first group (GTG#1-4); the HMI of GTG#7 and #8 transmit SOE data of the second group (GTG#5-8).

See attachment 00004-IN-A3-0625-G018 Sheet 2 & 3 for GTG 1 to 8 HMI and UCS interface and data flow arrangement.







III. TECHNICAL REQUIREMENTS

1. General scope of services

The work to be performed under this contract consists of furnishing all—labor, supervision, tools, equipment, technical and professional services, materials supplies and articles necessary to perform work involved with the replacement of the existing GTG 1 to 8 MARK V Simplex, and GTG 9 MARK V TMR, with GE recommended state-of-art MARK VIe or latest revision available simplex for GTG 1 to 8 eight(8) numbers and Triple Module Redundant (TMR) for GTG 9 one(1) number, maintaining the existing interface with UCS(plant wide DCS) for supervisory controls through MODBUS and interface with Global Server for SOE report generation for GTG 1 to 9 at Power and Water facilities of MARAFIQ at YANBU.

2. Engineering and design responsibilities

- a. The required professional services shall include complete design development, including the review of information provided in the contract documents, preparation of the final as-built drawings, and all necessary documents as required, upgrade of existing drawing/document/manuals reflecting the changes, and related other professional services in connection with, as specified herein, except as may be specifically excluded in the contract document.
- b. The engineering and design responsibilities, under this contract, shall include obtaining, research, and applying design information on relevant existing GTG 1 to 9 systems design documents/ drawings/manuals.
- c. Contractor shall review all of the program requirements and confirm an understanding of them with MARAFIQ concerned department. Following the pre-design meetings with the MARAFIQ at the site, the Contractor shall prepare a Preliminary functional design document describing in detail how the Upgrade of equipment/software will be adapted for use with the MARAFIQ facilities and with the procedures appropriate for operation of the GTG 1 to 9 MARK VIe/UCS within advance time from the Notice to Proceed.
- d. Engineering responsibilities shall include the detailed engineering for supply of state-of-art MARK VIe or latest revision available simplex for GTG 1 to 8 eight(8) numbers and Triple Module Redundant (TMR) for GTG 9 one(1) number to be replaced, configuration and design of application software/graphics, operational parameters for complete functional GTG 1 to 9 MARK VIe/UCS system.
- e. The Contractor is required to expand the engineering and design effort required to achieve complete familiarization with the existing facilities, elements and components for the UCS system as well as the technical documents covering existing MARK V systems and equipment in order to successfully upgrade and integrate the new GTG 1 to 9 MARK VIe latest revision model System hardware and software into the existing GTG 1 to 9 /UCS system. Familiarization with and obtaining information from other ongoing projects that impact the implementation of the GTG 1 to 9/UCS is also required.
- f. Contractor shall submit power load requirement analysis for the equipment to be upgraded.
- g. Contractor shall update the existing MARK V cabinet's hardware and software documents and operation and maintenance manuals covering MARK VIe or latest revision upgrade. The documentation shall include all vendor published standard hardware/software documentation and project specific custom documentations. Three (3) copies of entire configuration of the system shall also be provided on a suitable transportable storage medium and wherever possible in readable electronic format in addition to three (3) hard copies.
- h. The Contractor shall confirm that all SIL1, SIL2, SIL3 Instrument Protective Functions are Independent and provided in separate safety PLC and safety PLC is a certified SIS logic solver per the IEC 61508 series. The system supplied shall comply with IEC61508/61511 and is certified by third party such as TUV. GE needs to confirm how they will meet these requirements with new MARK Vie.

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(Note: Independency - All components used in SIL 1, 2 and 3 functions SHALL be independent of components used for monitoring and control functions.)

3. MARK VIe system capabilities:

Following are OEM GE product specific features abridged for reference only.

Mark VIe is a flexible control system for multiple applications supplied by GE. It features high speed, networked I/O for simplex, dual, and triple redundant systems. Industry standard Ethernet communications is used for I/O, controllers, and supervisory interface to operator and maintenance stations, and third-party systems. TOOLBOXST is used for Mark VIe and related controls as a common software platform for programming, configuring I/O, trending, and analyzing diagnostics. It provides a single source of quality, time-coherent data at the controller and plant level for effectively managing equipment assets.

A. Features:

Single board including:

Main Processor
Control Network Communications - Ethernet
IO Network Communications - Ethernet
USB and COM ports

Environment

Operating temperature 0°C to +65 °C No fans required

Mark VIe Controller



The controller is a single board, which is base-mounted in the cabinet. For dual and triple redundant systems, a second and third board can be mounted adjacent for a compact packaging arrangement. An 8349, 667 MHz processor is provided with a QNX operating system. Also, it does not require any cooling fans even at maximum temperature, and is suitable for NFPA Class 1, Div. 2 applications.

Each controller has three 100 MB Ethernet drivers for the IO Net, so that each

Controller can communicate with up to three network switches. In redundant systems, this allows each controller to monitor redundant inputs directly and compare them for any potential discrepancies. Connectors are color-coded and labeled to simplify maintenance. Controllers also have two Ethernet drivers for the control network to communicate

Peer-to-peer with other Mark VI, Mark VIe, and EX2100 generator excitation controls, as well as operator and maintenance stations. Controllers can be synchronized between units or to a local or remote time source for accurate plant wide sequence of events monitoring.

I/O Net

Communication between the controller and the I/O packs is performed with the Internal IO Net. This is a 100 MB Ethernet network available in non-redundant, dual redundant, and triple redundant configurations.

Operator Interface

The operator interface is commonly referred to as the Human-Machine Interface





(HMI). It is a computer with a Microsoft® Windows-based operating system, Client/server capability, a CIMPLICITY® graphics display system, and software Maintenance tools (Toolbox ST).

It can be applied as:

- > Primary operator station for one unit or the entire plant
- Maintenance station gateway
- Engineers station
- Gateway for communications

The HMI can be re-initialized or replaced with the process running with no impact On the control system. It communicates with the main processor board in the Mark VIe controller(s) through the control network Unit Data Highway (UDH) and to Third-party control and monitoring systems through the information network Plant Data Highway (PDH).

All local and remote data in the Mark VIe is accessible for screens with high-resolution time tags for alarms and events.

System (process) alarms for fault conditions are time-tagged at frame rate in the Controller and transmitted to the HMI alarm management system. System events are time-tagged at frame rate, and sequences of events (SOE) for contact inputs are time-tagged at 1 ms in the I/O packs. Alarms can be sorted according to ID, Resource, Device, Time, and Priority. Operators can add comments to alarm Messages or link specific alarm messages to supporting graphics.

A standard alarm/event log stores data for 30 days and can be sorted in chronological order or according to the frequency of occurrence. In addition, a trip history is provided that stores the key control parameters and alarms/events for the last 30 trips. This includes up to 200 alarms, 200 events, 200 SOE messages, and analog data before and after the trip. Data is displayed in English or Metric engineering units with a one-second update rate and one second to repaint a typical display graphic. Operator commands can be issued to increment/decrement a set point, or a numerical value can be entered for a new set point. Security for HMI users is important to restrict access to certain maintenance functions, such as editors and tuning capability, and to limit certain operations. A system called User Accounts is provided to limit access or use of particular HMI features.

Software Maintenance Tools (Toolbox ST)

Features

- Field programmable
- Floating point
- Dynamic data display
- Drag-and-Drop points
- Math blocks
- Macros (user blocks)
- Function and ladder blocks
- Multiple block libraries
- Editors for:
 - Application software
 - I/O assignments
 - Tuning constants
- Password protection
- Boolean and Analog forcing
- Trending Tools
 - Automatic uploads of Capture Blocks
 - Micro-second resolution
 - Drag-and-Drop variables to Trender







- Browser for variables selection
- 100s of signals per Trend
- Mask-Unmask of selected variables
- Video type Forward-reverse
- Left-right-drag of Time Axis
- Dual cursor
- Delta, Min, Max, Average
- Stacked Traces
- Alarm Messages on Trip Trend
- Events log linked to Trend
- Export to .CSV

HISTORIAN

The Turbine Historian has three main functions: data collection, storage, and retrieval. Data is stored in the Exception database for SOE, events, and alarms, and in the archives for analog values. Retrieval is through a web browser or standard trend screens.

A selection of tools, screens, and reports are available to ensure that the operator can make efficient use of the collected data as follows:

- Alarm and Event Report is a tabular display of the alarms, events, and SOE for all Mark VIe units connected to
 the Turbine Historian. This report presents the following information on a point's status; time of pickup (or
 dropout), unit name, status, processor drop number, and descriptive text. This is a valuable tool to aid in the
 analysis of the system, especially after an upset.
- Historical Cross Plot references the chronological data of two signal points, plotted one against another, for example temperature against revolutions per minute (RPM). This function permits visual contrasting and correlation of operational data.
- Event Scanner function uses logic point information (start, trip, shutdown, or user-defined) stored in the historical database to search and identify specific situations in the unit control.
- Event/Trigger Query Results shows the user's inputs and a tabular display of resulting event triggers. The data
 in the Time column represents the time tag of the specified Event Trigger.
- Process Data (Trends) is the graphical interface for the Turbine Historian and can trend any analog or digital
 point. It is fully configurable and can auto range
 - The scales or set fixed indexes. For accurate read out, the trend cursor displays the exact value of all points trended at a given point in time. The Turbine Historian can be set up to mimic strip chart recorders, analyze the performance of particular parameters over time, or help troubleshoot root causes of a turbine upset.

4. Applicable codes and standards

Marafiq is committed to the use of industry standards to create open systems for this procurement, the following standards or, latest equivalent shall be adopted and shall be observed in the subject contract to be upgraded. Codes and standards listed hereinafter constitute the design guidelines, whenever applicable, for the systems under provision; they do not substitute the contractual specifications. The following standards or, latest equivalent, shall be observed in the existing MARK V replacement, limited to the extent of the contractual scope detailed:

- a) MIL-STD ratings for vibrations,
- b) IEC standards for Overvoltage, Transient surge, Electrostatic discharge, Electromagnetic/radio frequency interference (EMI and RFI), and 3UL ratings for flammability
- c) Safety Standards





- Measurement, Control, and Laboratory Use, Part 1: General Requirements
- CAN/CSA 22.2 No. 1010.1-92 Safety Requirements for Electrical Equipment for Measurement,
 Control, and Laboratory Use, Part 1: General Requirements
- ANSI/ISA S82.02.01 1999 Safety Standard for Electrical and Electronic Test, Measuring, Controlling, and Related Equipment – General Requirements
- d) Printed wire board assemblies
 - UL 796 Printed Circuit Boards
 - ANSI IPC Guidelines
 - ANSI IPC/EIA Guidelines
- e) Electromagnetic Compatibility (EMC) EMC Directive 89/336/EEC as amended by 92/31/EEC and 93/68/EEC
 - EN 55081-2 General Emission Standard
 - EN 50082-2 Generic Immunity Industrial Environment
 - EN 55011 Radiated and Conducted Emissions
 - IEC 61000-4-2 Electrostatic Discharge Susceptibility
 - IEC 61000-4-3 Radiated RF Immunity
 - IEC 61000-4-4 Electrical Fast Transit Susceptibility
 - IEC 61000-4-5 Surge Immunity
 - IEC 61000-4-6 Conducted RF Immunity
 - IEC61000-4-11 Voltage Variation, Dips and Interruptions
 - ANSI/IEEE C37.90.1 Surge



- EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
- g) ATEX Directive 94/9/EC
 - EN 50021 Electrical Apparatus for Potentially Explosive Atmospheres

All components shall be designed in accordance with, and shall meet or exceed the requirements of the appropriate standards or equivalent. Where directly applicable standards are not available, related standards shall apply.

5. Scope of Supply

The scope of this specification is to define, in a clear and in definite way, the GTG 1 to 8 MARK V Simplex and GTG 9 MARK V TMR with GE recommended state-of-art MARK VIe or latest revision available simplex for GTG 1 to 8 and TMR for GTG 9

- 1. The scope of supply of this contract includes all engineering, design, procurement, construction, testing and commissioning necessary for the satisfactory replacement of the existing GTG 1 to 8 MARK V Simplex, and GTG 9 MARK V TMR, with GE recommended state-of-art MARK VIe or latest revision available simplex for GTG 1 to 8 eight(8) numbers and Triple Module Redundant (TMR) for GTG 9 one(1) number, maintaining the existing interface with UCS (plant wide DCS) for supervisory controls through MODBUS and interface with Global Server for SOE report generation. See reference drawing 00004-IN-A3-0625-G018.
- Contractor shall provide all the required equipment, and other associated appurtenances; supply of skilled manpower, transportation, and accommodation, testing and calibrating equipment, tools and instruments necessary for the proper implementation of the contract scope of work.
- Contractor shall perform the site survey, study the existing GTG 1 to 9 MARK V installation and interface with
 existing plant wide DCS henceforth referred to as UCS and provide in their bid document the exact details in





terms of quantity, specification, power consumption the suitable replacement for GTG 1 to 9 GE MARK VIe or latest revisions available.

- 4. GTG 9 MARKV is interfaced with EX2000 in existing setup, Contractor is required to provide all suitable interfaces in MARK VIe to communicate with existing EX2000 and have a fully functional system as existing.
- 5. Contractor shall provide Turbine Historian either in each HMI's of each GTG 1 to 9 or provide one (1) number suitable GE HISTORIAN SERVER machine with GE Turbine Historian software installed for historian purposes of all GTG's 1 to 9.
- 6. Contractor shall retrofit, GTG 1 to 8, eight (8) numbers HMI workstation's with eight (8) state-of-art GE HMI Operator stations. The HMI's will be located locally next to the MARK V panel in the PEECC shelter of each GTG 1 to 8. The eight (8) quantities HMI's shall provide full HMI server controls, monitoring and maintenance functions as the existing GTG 1 to 8 HMI's. These HMI's shall be a desktop configuration. Contractor shall supply eight (8) quantity 17 inches LCD monitors as part of supply along with the eight (8) HMI's computers which shall be GE recommended.

GTG 9 HMI's two (2) number have been replaced recently in 2010, GE to advice on its replacement/upgrade. If GE decides to replace with new HMI's similar to GTG 1 to 8 HMI's than GE shall upgrade the existing GTG9 two (2) number HMI's to be suitable with the MARK VIe upgrade and provide it as spare to MARAFIQ.

- 7. Contractor shall Interface the ten (10) HMI's HMI's with Unified Control System, UCS (DCS) using existing DCS MODBUS Interface. Contractor to use all the existing communication and interface hardware to interface the new ten (10) HMI's to be supplied under the scope of work. Contractor shall be responsible to make all the necessary changes in UCS hardware/software to have a seamless operation of GTG 1 to 9 from UCS.
- 8. Contractor shall Interface the new ten (10)HMI's HMI's with existing Global Sequence of Event Recorder Server supplied under package C-004 in the similar configuration as stated above using Ethernet TCP/IP. Contractor shall make the necessary changes in software and hardware to interface seamlessly to the existing Global Sequence of Event Recorder Server in UCS.
- 9. It shall be contractor's responsibility to have ABB, Genoa, Italy to carry out any modification job required in UCS, testing the UCS MODBUS protocol and Global SOE server data acquisition.
- 10. The scope and price for the replacement of the existing GTG 1 to 8 MARK V Simplex, and GTG 9 MARK V TMR, with GE recommended state-of-art MARK VIe or latest revision available simplex for GTG 1 to 8 eight(8) numbers and TMR for GTG 9 one(1) number shall also include the removal of the existing GTG 1 to 9 MARK V panels, any and all new instrument cabling, network cable connections, new Mark V PROM installation (if required), start-up and commissioning of the new MARK VIe or latest revision control systems and each Turbine units and interfaces at various functional level with MARK VIe controls and also with Unified Control System(UCS).
- 11. These modifications as stated above shall be engineered in such a way that the performance and the functionality or response times of the existing system shall not be degraded in any way in UCS. Modification programming, configuration and implementation shall be exactly the same as the existing system and shall be based on the existing documentation provided to GE.
- 12. The new MARK VIe /HMI's of each GTG's 1 to 9 shall be time synchronized with GPS in the similar way as the existing setup and hardware. It shall be contractor's responsibility to study the existing GPS hardware and conform to the requirements with new MARK VIe or latest revision of GE.
- 13. Upgrade the graphics display in the new GTG 1 to 9 HMI in accordance with the displays provided in existing GTG 1 to 9 HMI's.
- 14. The GTG 1 to 9 new HMI's shall be configured for generating all the reports that are existing in the present system and all the new reports that would be required by Operation. Post trip and Pre trip reports are to be configured and made available in the GTG 1 to 9 new HMI's under the scope of supply and UCS.

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- 15. Contractor shall provide new printers in each GTG's 1 to 9 for all alarm printing. The Contractor to configure the printer with the new GTG 1 to 9 HMI's under scope of supply. The supply of type of printers shall be approved by MARAFIQ.
- 16. Contractor shall warranty the complete MARK VIe replacement equipment under scope of supply for 1 year. All upgrades and software patches shall be provided with clear written instruction to be implemented by MARAFIQ during the period of warranty and after at no cost to MARAFIQ.
- 17. Contractor shall provide pressure transmitter nine(9) numbers in each GTG's 1 to 9 Hydraulic Supply system as indicated on drawing IOR181 -736 for GTG 1 to 8 & 33286075 for GTG 9. The pressure transmitter shall be wired to new MARK VIe or latest revision control system and shall provide continuous monitoring in MARK VIe HMI graphics and shall be further interfaced via MODBUS to UCS/DCS. The DCS graphics shall be modified accordingly to show the hydraulic pressure monitoring. The transmitter shall also have in built provision for field reading on LCD display.
- Contractor shall provide a comprehensive quotation with complete replacement philosophy, Device transition plan, manpower, break-up and time schedule.
- 19. Contractor shall prepare and submit for MARAFIQ approval, cutover plan (Device Transition Plan, DTP) detailing the work to be carried out prior to commencement of modification/replacement work. The purpose of this plan is to ensure that during the cut-over, there is no unscheduled data loss and operational emergencies to any of the equipment. The plan shall be in narrative form, describing the work sequence and the method of implementing of the entire activities with minimum services downtime.
- 20. The work program requires complete familiarization with existing GTG 1 to 9, UCS installations, systems, facilities and equipment. Complete sets of approved technical documents covering these existing installations, systems, facilities and equipment must be on hand with the Contractor throughout the duration of the work that would be the basic reference for the rendered service. The Contractor shall be responsible for updating of the entire existing document and wherever required in the O&M manuals. If the power supply wiring drawings are not provided in the existing then the contractor is required to provide the drawings.
- Contractor shall provide the network drawings and all the required configuration documents for network details.
- 22. Contractor shall verify the GTG 1 to 9 and UCS MODBUS interface. If any modification of UCS TENORE HMI Graphics pages is required due to modification in GTG 1 to 9 new MARK VIe replacement, then contractor shall co-ordinate with GE-ABB to provide updated display in UCS TENORE HMI's of GTG 1 to 9 Cluster in CCB Bldg. 13 and Local TENORE Cluster Bldg. 11B.
- 23. GTG 1 to 9 MARK V retrofit/replacement under the scope of supply shall be engineered in such a way that the performance and the functionality or response times of the existing system shall not be degraded in any way in UCS. Modification programming, configuration and implementation shall be exactly the same as the existing system and shall be based on the existing UCS design criteria.
- 24. Contractor's scope of work includes all Ethernet and Fiber optic cable and termination devices provision, verification, modification, replacement as required for the contract scope of work for replacement of MARK V with MARK VIe or latest revision and also Ethernet and Fiber Optic requirement if any to interface with UCS as provided in existing under UCS package C-004.
- 25. Contractor shall co-ordinate all the replacement of GTG 1 to 9 MARK V retrofit/replacement with all safety precautions and procedures so as to eliminate interruptions to critical process functions and not to jeopardize services of the systems and facilities involved.
- 26. The replacement of GTG 1 to 9 MARK V retrofit/replacement shall be the exact replacement to fit the existing mechanical structure of the existing. Any deviation shall be clearly stated in the bid document and shall be subjected to MARAFIQ approval.
- 27. Contractor shall, before replacement note all the errors in each GTG 1 to 9 MARK V and in case they exist shall inform maintenance/operation. After the replacement of GTG 1 to 9 MARK V and in case they exist shall inform maintenance/operation.

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- GTG 1 to 9, contractor shall fully restore each GTG's and hand over the functional GTG 1 to 9 and UCS system to the satisfaction of MARAFIQ O&M.
- 28. Contractor shall verify all conditions on the jobsite applicable to this work and shall notify in writing of discrepancies, conflicts, or omissions promptly upon discovery. If conditions exist at the job site which makes it impossible to install work in the existing structure/space, recommend solutions and / or submit drawings to the MARAFIQ for approval, showing how the work may be installed.
- 29. Contractor shall be responsible to retrieve and verify the existing drawings from MARAFIQ documentation center, site specific measurements for mechanical structure and other related site specific specials, power supply connection details and all associated objects and links in order to have the same functionality provided in the existing and provide a complete functional and updated GTG 1 to 9 MARK V replacement with state-of-art MARK VIe or latest revision. Contractor shall seek proper coordination and approval from MARAFIQ concerned department.
- 30. Contractor shall warranty the GTG 1 to 9 MARK V replacement with state-of-art MARK VIe or latest revision under the scope of supply for one (1) year after initial acceptance. All Technical Bulletins related to GTG 1 to 9 MARK VIe shall be provided with clear written instruction for MARAFIQ consideration during the period of warranty and after at no cost to MARAFIQ.
- 31. Contractor shall provide the minimum/maximum Recommended Operational Spare Parts (RSPL) for three (3) years of life of the replaced GTG 1 to 9 MARK VIe Equipment with Min/Max quantities recommended by manufacturer. Contractor shall provide the cost quote for recommended spare parts and Marafiq shall approve the quantity required. The requirement shall be optional quote from the contractor.
- For all UCS testing and configuration requirements, the contractor shall consult M/s ABB, GENOA, ITALY and
 as required for contract scope, M/s ABB GENOA, ITALY shall be hired for all modification and configuration
 works in UCS.
- 33. The scope of supply shall also include vendor's supervisory services for testing, commissioning, trial run and performance-testing for the new GTG 1 to 9 MARK VIe replacement, testing and GTG 1 to 9 startup in accordance with the contract.
- 34. Contractor shall provide all OEM GE standards and site specific training to 10 MARAFIQ deputed personnel's (eight from the O&M and two from TSD). All training shall be approved and coordinated by contractor with MARAFIQ training department
- 35. The scope of supply shall also include services and materials for decommissioning and removal of the existing GTG 1 to 9 MARK V equipment. All the decommissioned equipment shall be tagged, transported and handed over to MARAFIQ designated area.
- 36. The Contractor shall study the SOE (sequence of events) configuration of GTG 1-8 and GTG-9. SOE configuration in GTG1-8 and GTG-9 needs to be studied for all associated electrical protection signals trips and such shall be provided in new upgraded Mark Vie. All additional Input/Outputs hardware, Terminal Blocks, Modules, Interposing Relays and wiring shall be provided for all associated electrical protection signals causing the trips. Accordingly UCS SOE shall be modified by ABB to meet the Mark Vie upgrade. The Contractor shall provide the detailed technical description along with BOM for SOE upgrade of Mark V to Mark Vie in their bid document.
- 37. The Contractor shall develop detailed cause and effect matrix based on the trip logic for GTG 1-8. Contributive trip signals shall be provided in GTG 1 to 9 SOE in Mark Vie and SOE report shall be comprehensive in providing the actual cause of the trip for following but not limited to.
 - (a) Turbine Sequence (Start up and Shutdown)
 - (b) Basic Auxiliaries involved
 - (c) Mani Control Mode relating to various stages turbine operation
 - (d) Protection Scheme







38. Technical Requirement and Specification of Control System for GTG 1-8

Type Frame 7E Existing

Speed Tronic Mark V -Simplex

Upgradation

Speed Tronic Mark VIe-Simplex

Control, Excitation, Regulation and

Protection Panel

Control, Excitation, Regulation and

Protection Panel

Operator Interface

Local HMI

Local HMI and Remote HMI-

SEE NOTE-1

39. Technical Requirement and Specification of Control System for GTG 9

Type

Existing

Local HMI

Speed Tronic Mark V -TMR

Upgradation

Speed Tronic Mark VIe-TMR

Frame 7EA
Gas Turbine

Operator Interface

Control, Excitation, Regulation and

Control, Excitation, Regulation and

Protection Panel

Generator

Protection Panel

Local HMI and Remote HMI-SEE NOTE-1

NOTE-1: Remote HMI will be common for GTG 1-9 unit and shall be installed in CCB.

- 40. The Contractor shall perform detailed site survey to proceed with upgrading, just to avoid any problem consequent to the unavailability of information or data and to reduce the necessary time for the final set-up, before to start the project, it is necessary to proceed with a detailed site survey and a full backup, including Data base of Modbus communications with other (ABB UCS) system. This step will include the extraction of the existing Mark V system data like database tags, graphics, trends, logs, event lists and functional areas and ISO image done with Acronis application.
- 41. The Contractor shall provide site audits to analyze control system hardware, and software levels. Site audit report shall clearly explain the most effective migration path towards the latest technology.
- 42. The Contractor is required to provide disaster recovery system (like Acronis Backup or equivalent) of each GTG.
- 43. The Contractor shall provide extended support for Mark Vie System software versions including following but not limited
 - Software security management
 - Microsoft security patch validation status
 - Third party virus scanner qualification and management
- 44. The Contractor shall study IPF (Instrument Protective Function) for retrofitting of proposed Mark Vie control system in compliance with Standards IEC61508 and IEC61511 for existing GE Frame 7E and 7EA gas turbine. Actual SIFs for critical protection loops including SIL assessment for existing Gas Turbine Generators shall be determined by the contractor based on the site equipment configuration and accordingly all retrofitting work shall be performed to meet the requirements of IEC61508 and IEC61511.
- 45. The Contractor shall conduct/perform HAZOP studies in compliance with IEC 61882 for existing GTG and SIL assessment and Safety Integrity Level (SIL) studies for critical protection of existing Gas Turbine Generators per IEC 61508/IEC61511 including following but not limited.





- A. Hazard and risk assessment
- B. SIL assessment
- 46. Above, "A" & "B" SHALL be carried out on hazardous GTG's processes and its associated equipment.

It shall result in

- 46.1 A description of each identified hazardous event and the factors that contribute to it;
- 46.2 A description of the consequences and likelihood of the event;
- 46.3 Consideration of conditions such as normal operation, start-up, shutdown, etc.;
- The determination of requirements for additional risk reduction necessary to achieve the required safety;
- A description of, or references to information on, the measures taken to reduce or remove hazards and risk;
- A detailed description of the assumptions made during the analysis of the risks including probable demand rates and equipment failure rates, and allocation of the safety functions to layers of protection taking account of potential reduction in effective protection due to common cause failure between the different layers.
- 46.7 SIL assessment report shall have <u>test frequencies and test procedures</u> for all <u>Instrument Protective functions (IPF)</u> provided.

Such studies do not exist in GTG's within MARAFIQ and we need GE (The Contractor) to provide us with.

5.1. Technical submittals

Contractor shall submit to MARAFIQ for review and approval of the followings:

- The information listed for Documentation is regarded as general guidelines. Specific document requirements shall be defined during detailed design development.
- 2. A documentation plan shall be submitted that provides a detailed description of the Contractor's plan for the project documentation. The plan shall serve as a documentation checklist throughout the project and shall be revised and resubmitted by the contractor as necessary. This plan shall include the following information for each documentation submittal:
 - a. Documentation name
 - b. Document number
 - c. Document class
 - d. Submittal data
 - e. All revisions and dates
 - f. Required review data
 - g. Number of copies for each document, three (3).
- 3. Every Design Package must be reviewed and approved by MARAFIQ until release of such package is considered approved final by MARAFIQ for implementation.

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- 4. All Contractor supplied documentation shall be consistent in terms of format, structure, section and page numbering, the use of symbols, etc. and shall have a complete Table of Contents. All documentation shall be provided in English language.
- 5. Before commencing the work contractor shall submit Shop Drawings on standard A1 or A3 size indicating details of design, plans and dimensions. All shop drawings shall be in <u>MICROSTATION</u> format. Contractor shall coordinate with Marafiq Documentation Center for all documentation requirements.
- All documents, shop drawings, technical submittals and related manuals shall be provided in hard copy as well as soft readable formats.
- The contractor shall submit copies of catalog for all server/workstation equipment, materials and products including manufacture's certification that the materials complying with the required standards/specifications.
- All equipment, materials, cables and wires and other misc. items required on this project shall be submitted for approval before procurement.
- The contractor shall submit installation/erection drawings for new equipment and demolition drawings for existing to remove equipment under this proposed modification.
- 10. The contractor shall submit a detailed method statement (DTP, Device Transition Plan, cut-over plan) for installation and termination of proposed equipment within advanced from Notice to Proceed.
- 11. The contractor shall submit Operation & Maintenance Manual(s), containing trouble shooting instructions and manufacturer's Recommended Spare Parts List with supporting literatures.
- The contractor shall submit commissioning procedures for commissioning.
- 13. The contractor shall submit final As-Built drawings, As-Built Document, before demobilization from the project site prior to initial acceptance.
- 14. All documents and associated drawings shall be in accordance with the latest revisions of applicable codes and standards.
- 15. Contractor shall modify all the required existing document (O&M manuals) and existing drawings as required and deemed necessary for the subject project.

5.2. Inspection and testing

- 1 Within forty five (45) days after the Notice of award of the contract, contractor shall submit an inspection and testing Plan, for MARAFIQ review and approval.
- 2. MARAFIQ reserves the right to witness all of testing and inspection activities per approved plan. Test records shall be submitted for the entire system.
- 3. The contractor shall carry out all off-Site and on-Site inspection and testing of the entire system. The MARAFIQ shall have the right to reject any part of the work reasonably found unsatisfactory or not acceptable on the basis of results of such inspection and testing.
- 4. The contractor shall give at least one (1) week advance notice to MARAFIQ to witness any of the onsite test and inspection activities per approved schedule.
- 5. The contractor shall report to and work to the schedule requirements of the contract and MARAFIQ work times.

5.3. Recommended spare parts

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- The contractor shall prepare and submit a list of recommended operational spares for three (3) years of life of the replaced MARK VIe or latest revision Equipment.
- The contractor shall submit RSPL of each piece of equipment followed by the technical approval of the Preliminary Equipment list (PEL) by MARAFIQ.

5.4. Reference Documents

The following listed existing documents shall be accessible to the contractor on request. These documents shall be available for bidder's reference only.

21	02004-IN-A4-0642-G003	GTG 3 MARK V I/O Report List
22	02004-IN-A4-0648-G004	GTG 4 MARK V I/O Report List
23	02004-IN-A4-0654-G005	GTG 5 MARK V I/O Report List
24	02004-IN-A4-0660-G006	GTG 6 MARK V I/O Report List
25	02004-IN-A4-0666-G007	GTG 7 MARK V I/O Report List
26	02004-IN-A4-0672-G008	GTG 8 MARK V I/O Report List
27	336A5980IO	GTG 9 MARK V I/O Report List
28	02004-IN-A4-0680-G001	GTG 1 MARK V/UCS MODBUS PROTOCOL DATA LIST
29	02004-IN-A4-0681-G002	GTG 2 MARK V/UCS MODBUS PROTOCOL DATA LIST
30	02004-IN-A4-1533-G003	GTG 3 MARK V/UCS MODBUS PROTOCOL DATA LIST
31	02004-IN-A4-1534-G004	GTG 4 MARK V/UCS MODBUS PROTOCOL DATA LIST
32	02004-IN-A4-1535-G005	GTG 5 MARK V/UCS MODBUS PROTOCOL DATA LIST
33	02004-IN-A4-1536-G006	GTG 6 MARK V/UCS MODBUS PROTOCOL DATA LIST
34	02004-IN-A4-1537-G007	GTG 7 MARK V/UCS MODBUS PROTOCOL DATA LIST
36	02004-IN-A4-1538-G008	GTG 8 MARK V/UCS MODBUS PROTOCOL DATA LIST
		+
37	336 A 5980	GTG 9 MARK V/UCS MODBUS PROTOCOL DATA LIST
38	02004-IN-A4-0631-G001	GTG 1 MARKV Alarm Database
20		
20		
39	02004-IN-A4-0637-G001 02004-IN-A4-0643-G001	GTG 2 MARKV Alarm Database



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41	02004-IN-A4-0649-G001	GTG 4 MARKV Alarm Database
42	02004-IN-A4-0655-G001	GTG 5 MARKV Alarm Database
43	02004-IN-A4-0661-G001	GTG 6 MARKV Alarm Database
44	02004-IN-A4-0667-G001	GTG 7 MARKV Alarm Database
45	02004-IN-A4-0673-G001	GTG 8 MARKV Alarm Database
46	336A5980	GTG 9 MARKV Alarm Database
47	00004-IN-A3-0625-G018	UCS- GTG UNIT 1 to 8 SYSTEM LAYOUT AND
		INTERCONNECTION
48	272B3508	GTG 9 Interconnection/Network topology
49	331DF22962	Elementary Diagram for GTG 1,3,5,7
50	331DF26083	Elementary Diagram for GTG 2,4,6,8
51	00004-EE-A1-3531-G000	125V DC Power Distribution Bldg 11A, sh1,2
52	00004-IN-A3-3754-G000	Cable Schedule
53	00004-IN-A1-3755-G000	Cable Block diagram (Power Cables)
54	00004-IN-A1-3708-G000	GTG 1-8 System Cable Block Diagram
55	006Q-P01-674	One Line diagram of unit 480V/120/208V & 125V DC
56	01369-EE-A0-5051	Unit 1-8 Gas turbine Area Electrical Layout
57	01369-EE-A0-105	Gas Turbine Bldg 11, layout of main cable raceway
58	23635- C-004	Instruction manuals GAS Turbine & Generators, Vol. 1 to
		9
59	UCS-EB-0617	GAS TURBINE CONTROL SYSTEM UNIT 1-8 PHILOSOPHY
		OF INTEGRATION INTO UCS
60	UCS-EB-0108revC	HRSG 5-GTG 9 DESIGN CRITERIA
61	UCS-EB-0084	HRSG 1-4 DESIGN CRITERIA
62	UCS-EB-0620B	GTG 1 to 8 Electrical Load List
63	331DF22962	DC Distribution Sheet M43C, Mark V Power Supply
64	VAR-SK-0220	Method Statement 125V DC in GTG Shelters
65	00004-IN-A1-3597-G018	Cable and Conduit Section Details
66	00004-IN-A3-1140-G018	GTG 1 to 8 Functional Compartment Layout
67	IOR181 -736	GTG 1 to 8 Piping Diagram Hydraulic System
		orgonii ni u lina
68	33286075	GTG 9 Piping Diagram Hydraulic System







SECTION - IV D

REPLACEMENT OF COMPRESSOR & UNBUCKETED TURBINE ROTOR ASSEMBLY OF GTG 1 – 8 EXCEPT GTG NO.3







I. General Information

Gas turbine unit

The gas turbine unit part of the turbine compartment is that portion, exclusive of control and protection devices and the generator equipment, in which fuel and air are used to produce shaft horsepower. The 17-stage compressor rotor is larger than, but generally similar in design to, earlier successful gas turbine compressors with individual rotor disc for each stage. Through bolts connect the rotor discs to the forward and aft stub-shafts. The turbine rotor is similarly stacked, with spacer pieces between the first- and second- stage and the second- and third-stage wheels.

The gas turbine rotor incorporates a three-bearing design that utilizes pressure-lubricated, elliptical journal bearings. The three-bearing design provides assurance that rotor critical speeds are higher than the operating speed range; permits rapid turbine starting, loading and stopping; and results in an ability to maintain close compressor and turbine blade (bucket) clearance for greater component efficiency and high power output.

All three-turbine stages have precision-cast, long shank buckets (the individual airfoils on the compressor wheels are called blades, while those on the turbine wheels are called buckets). This innovation effectively shields the wheel rims and bucket bases from the high temperatures of the main gas stream. Turbine wheels are cooled by air extracted from the compressor discharge and 17th stages that is then ducted through the rotor bore to points of introduction at the wheel faces. Wheel space temperatures are monitored by thermocouples.

The turbine unit casings are split and flanged horizontally for convenience of disassembly. Compressor discharge air is contained by a separate, fabricated outer shell.

All three turbine stages utilize precision-cast, segmented nozzles. The second- and third-stage nozzles encompass a simplified arrangement, with the nozzles segments supported from stationary shrouds. This arrangement removes the hot-gas from contact with the turbine shell.

The MS-7001E gas turbine can be designed to operate on, distillate oil, or gaseous hydrocarbon fuel.

Hitachi Gas Turbine Generator design Data 2.

The following table lists YANBU Gas Turbine Generator design data:

Altitude.....Sea Level

Shaft Rotational speed................3, 600 rpm

Lubricating Oil Reservoir

Capacity.....11,000l

Fuel..... Ethane gas / Distillate Oil.

Compressor stages......17

Turbine Stages...... 3

Starting Means......670 kW electric motor

Loading Time

Normal.....20 minutes

Fast Load......9.5 minutes

Rated Load, Sales Gas at site (50 C)

Simple-cycle

Combined-cycle

Base56, 570 kW

55, 720 kW

Peak..... 62, 310 kW

61, 370 kW







Rated Load, Distillate oil at site (50 C)

Simple-cycle

Base..... 56, 170kW Peak...... 61, 710 kW Combined-cycle 55, 320 kW 60, 780 kW

Total GTGs Running Hours up to December, 2014

Gas Turbine Unit No.	GTG #1	GTG #2	GTG #3	GTG #4	GTG #5	GTG #6	GTG #7	GTG #8
Overall running	197,362	187,603	182,168	198,148	190,309	186,083	188,208	189,755







II. TECHNICAL REQUIREMENTS

1. General scope of services

MARAFIQ intends to go for GTG frame 7001E rotors replacement, since all Gas Turbine Generator's rotors have reached to 200K. Replacement is also confirmed by two external consultants KEMA/ ATTS and General Electric. The work to be performed under this contract consists of furnishing all labor, supervision, tools, equipment, technical and professional services, materials supplies and articles necessary to perform work involving "is to replacement of GTG's rotors". The results of replacement should serve as a basis to predict the Life Time expectancy of the Frame-7001E Gas Turbines Compressor and Turbine Rotor Shaft except GTG-3.

2. Engineering and design responsibilities

- c) The required professional Replacement shall include review the complete design, development, the final asbuilt drawings and other required documents necessary and related professional services in connection with the as specified herein, except as may be specifically excluded in the contract document.
- d) The engineering and design responsibilities, under this contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/ drawings by utilizing technical documents from the Owner's files.

3. Applicable codes and standards

- f) The contractor shall comply with the applicable parts of the following industry codes & standards as basis for all types of engineering & construction works.
- g) American Petroleum Institute API-616 for Gas Turbine.
- h) American Petroleum Institute API-687 for Rotor Repair.
- i) American National Standards Institute (ANSI)
- j) American Society for Testing and Materials (ASTM)
- k) Saudi Arabian Standards Organization (SASO)

4. Rotor Replacement

The contractor will install the compressor & turbine un-bucketed rotor with due diligence.

a) Rotor specification

Rotor length: 7803 mm & total weight of bladed rotor: 50600 kg.

All piping should be removed above & side of the turbine & compressor casing

b) <u>Turbine casing jacking.</u>

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The compressor & turbine casing will be jacked with hydraulic jacks according to OEM recommendation.

Unbolt the casing & lifted carefully with tested slings & chain blocks at marked positions.

c) Lifting of Rotor

- The rotor is lifted from the casing & installed with lifted beam & sling (special tool).
- Pay attention for select of lifting position.
- Insert sheet metal protector for rotor between rotor & wire rope.
- The rotor is equipped with 17 stages of compressor & un-bucketed of turbine rotor.

d) Rotor Adjustment

The rotor will be adjusted according to OEM recommendations. Measure all clearances of compressor rotor with compressor stator blades & turbine buckets with stationary nozzles. The rotor thrust clearance will be adjusted as per OEM recommendations. Measure the rotor bump test.

e) <u>Technical submittals</u>

The contractor will submit all inspection report to Marafiq for the review & approval.

f) Quality Assurance

The contractor shall be responsible to ensure that all rotor removal & installation, materials, equipment's and workmanship provided under this contract is in compliance with the contract provision applicable codes and standard and sound engineering and construction practices.

g) Inspection and testing

Except GTG-3, MARAFIQ shall have the right to reject any part of the work reasonably found to be unsatisfactory or not acceptable on the basis of results of such inspection and testing.

- a) In case of shaft re-balding the following tests shall be included but not Limited to those tests: -
 - Compressor Rotor Disc Dimensional Inspection.
 - Compressor Rotor Blade Inspection.
 - Rotor Clearance Inspection.
 - Shaft Run out.
 - Rotor Over Speed Test.
 - Shaft Dimension.
 - Sealing Area.
 - Critical Speed.
 - Rotor Stabilizing Analysis.
 - Rotor Dynamic Balancing Test after assembly.
 - Wheel bore regions inspection.
 - Buckets dovetail fits inspection







h) Reference drawings

The following ref. drawings shall be provided herewith for concept only.

erial Number	Drawing Number	Description
1	10P- 077- 663	Assembly of Gas Turbine
2	10Q - 134 - 326	Compressor Rotor
3	10P- 087- 592	Turbine Rotor

5. Acceptance Criteria

Operation and test run of each GTG's with Complete Rotor in Turbine, to ensure the each Gas Turbine Generators (for GTG 1 to 8) to Improve Heat Rate & Assurance with supporting evidence for the higher reliability achieved through advanced technology.







SECTION - IV E

EXTENDOR PARTS OF GTG # 1 -8









I. General Information

Brief about the Gas turbine unit

The gas turbine unit part of the turbine compartment is that portion, exclusive of control and protection devices and the generator equipment, in which fuel and air are used to produce shaft horsepower. The 17-stage compressor rotor is larger than, but generally similar in design to, earlier successful gas turbine compressors with individual rotor disc for each stage. Through bolts connect the rotor discs to the forward and aft stub-shafts. The turbine rotor is similarly stacked, with spacer pieces between the first- and second- stage and the second- and third-stage wheels.

The gas turbine rotor incorporates a three-bearing design that utilizes pressure-lubricated, elliptical journal bearings. The three-bearing design provides assurance that rotor critical speeds are higher than the operating speed range; permits rapid turbine starting, loading and stopping; and results in an ability to maintain close compressor and turbine blade (bucket) clearance for greater component efficiency and high power output.

All three-turbine stages have precision-cast, long shank buckets (the individual airfoils on the compressor wheels are called blades, while those on the turbine wheels are called buckets). This innovation effectively shields the wheel rims and bucket bases from the high temperatures of the main gas stream. Turbine wheels are cooled by air extracted from the compressor discharge and 17th stages that is then ducted through the rotor bore to points of introduction at the wheel faces. Wheel space temperatures are monitored by thermocouples.

The turbine unit casings are split and flanged horizontally for convenience of disassembly. Compressor discharge air is contained by a separate, fabricated outer shell.

All three turbine stages utilize precision-cast, segmented nozzles. The second- and third-stage nozzles encompass a simplified arrangement, with the nozzles segments supported from stationary shrouds. This arrangement removes the hot-gas from contact with the turbine shell.

The MS-7001E gas turbine can be designed to operate on, distillate oil, or gaseous hydrocarbon fuel.

2. Hitachi Gas Turbine Generator design Data

The following table lists YANBU Gas Turbine Generator design data:

Altitude.....Sea Level

Shaft Rotational speed......3, 600 rpm Lubricating Oil Reservoir

Capacity......11,0001

Fuel..... Ethane gas / Distillate Oil.

Compressor stages......17

Turbine Stages...... 3

Starting Means......670 kW electric motor

Loading Time

Normal.....20 minutes

Fast Load......9.5 minutes

Rated Load, Sales Gas at site (50 C)

Simple-cycle

Combined-cycle

Base56, 570 kW

55, 720 kW

Peak..... 62, 310 kW

61, 370 kW





Rated Load, Distillate oil at site (50 C)

Simple-cycle

Combined-cycle

Base..... 56, 170kW

55, 320 kW

Peak..... 61, 710 kW

60, 780 kW

Total GTGs Running Hours up to December, 2014

Gas Turbine Unit No.	GTG #1	GTG #2	GTG #3	GTG #4	GTG #5	GTG #6	GTG #7	GTG #8
Overall running	197,504	188,347	182,912	198,339	190,309	186,083	188,950	190,401







II. TECHNICAL REQUIREMENTS

1. General scope of services

MARAFIQ intends to go for GTG frame 7001E Extendor replacement, since all Gas Turbine Generator's rotors have reached to 200K. Replacement is also confirmed by two external consultants KEMA/ ATTS and General Electric. The work to be performed under this contract consists of furnishing all labor, supervision, tools, equipment, technical and professional services, materials supplies and articles necessary to perform work involving "Extendor".

2. Engineering and design responsibilities

- e) The required professional Replacement shall include review the complete design, development, the final asbuilt drawings and other required documents necessary and related professional services in connection with the as specified herein, except as may be specifically excluded in the contract document.
- f) The engineering and design responsibilities, under this contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/ drawings by utilizing technical documents from the Owner's files.

3. Applicable codes and standards

- a) The contractor shall comply with the applicable parts of the following industry codes & standards as basis for all types of engineering & construction works.
- b) American Petroleum Institute API-616 for Gas Turbine.
- c) American Petroleum Institute API-687 for Rotor Repair.

4. Proposed Modification

Marafiq is considering replacement of complete Extendor parts in Combustion system modification as a package unit with a new unit for each Gas Turbine Generators (for GTG 1 to 8). The existing 56.2 MW Gas Turbine Generators Frame 7001E (for GTG 1 to 8) is Hitachi Manufactured, licensed from GE. Further, each of the two gas turbines is connected to one HRSG. The proposed modification consists of

- 1. Power down unit and control panel
- 2. Remove affected combustion components
- 3. Send combustion components to authorized GE Repair Shop for modifications
- 4. Reinstall modified combustion components

To perform the benefits of Extendor Replacement the following benefits as follows:

Extendor reduces combustion component wear by:

- Reducing the relative movement between combustion components.
- Reducing forces and vibrations at wear interfaces.
- Providing for critical clearance control at wear interfaces.
- Using proven wear-resistant material couples developed by GE.

The Extendor Combustion System was developed to reduce the effects of wear at the following key interfaces:

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- Liner Stops.
- Fuel Nozzle Tip to Combustion Liner Fuel Nozzle Collar.
- Combustion Liner Hula Seal to Transition Piece Forward Sleeve.
- Transition Piece Forward Supports and Bracket.
- Transition Piece Aft Picture Frame Seal.

MS7001E Extendor Combustion Systems

Extendor can be applied to the following Frame 71E combustion components:

Frame 7/1E units with TBC coated slot cooled diffusion combustion liners and slotted end frame Nimonic transition pieces.

Frame 7/1E standard combustion systems with water injection with Breech-load fuel nozzles are required to realize the full interval extension.

MS7001E Transition Piece Extendor Combustion System

This Extendor package is a subset of the MS7001E Standard Extendor Combustion System described above. This Extendor package is applied to the transition piece and liner hula seal only.

Application of this Extendor system allows users to conduct mini-combustion inspections by removing the liners and leaving the transition pieces in the unit (refer to Combustion Inspection Intervals section later in this document). This will result in shorter outages and lower repair costs by eliminating the need to remove and repair transition pieces.

MS 7001 E Extendor List of Components used for modification one GTG as follows

- 1. Combustion Liner
- 2. Flow Sleeves
- 3. Fuel Nozzle tips
- 4. Cross fire tubes and cross fire tube retainers
- 5. Three Wear resistant 'Lug" Type liner stops
- 6. Increased clearance -fuel nozzle/Liner collar
- 7. Hardened fuel nozzles & cap collars with Anti Rotation stops
- 8. Hardened fuel Nozzle & Cap collars with anti-rotation stops
- 9. Wear cooling on Hula seal
- 10. Boss for wire type cross fire tube retainer
- 11. Three wear resistant flow sleeve stops
- 12. Two piece crossfire tubes & wire type retainers
- 13. Reduced gas tip diameter
- 14. Wear coating on Gas tips
- 15. Sacrificial wear covers
- 16. Wear coating on forward sleeve(Interior)
- 17. Hardened guide block (H- Blocks)
- 18. Sacrificial wear strips in end frame slots
- 19. Hardened floating seal stops (Rat ears)
- 20. New TP seals (Side and liner & Outer Floating seals)

Inspection and Testing







Provide all test instrumentation, equipment and accessories necessary for demonstration and putting the equipment into operation before commissioning. All testing equipment shall be calibrated by approved authorities and calibration certificates shall be submitted to Marafiq representative for their review and approval.

5. Acceptance Criteria

Operation and test run of each GTG's Extendor parts in Combustion system modification as one package, to ensure the Following Expected Combustion inspection intervals can be extended by reducing wear a Combustion system components and increasing unit availability.

Combustion inspection intervals fired hour limits	Water
7001E 24K CI Extendor System	12000

And the bidder shall take dismantled Part from modification of the Extendor and Available Capital Spares from Marafiq Ware house in the Parts Exchange Programme.







SECTION - IV F

FULL UNIT UP
RATES of GTG # 1 -8, EXCEPT GTG
NO. 3







I. General Information

3. Gas turbine unit

The gas turbine unit part of the turbine compartment is that portion, exclusive of control and protection devices and the generator equipment, in which fuel and air are used to produce shaft horsepower. The 17-stage compressor rotor is larger than, but generally similar in design to, earlier successful gas turbine compressors with individual rotor disc for each stage. Through bolts connect the rotor discs to the forward and aft stub-shafts. The turbine rotor is similarly stacked, with spacer pieces between the first- and second- stage and the second- and third-stage wheels.

The gas turbine rotor incorporates a three-bearing design that utilizes pressure-lubricated, elliptical journal bearings. The three-bearing design provides assurance that rotor critical speeds are higher than the operating speed range; permits rapid turbine starting, loading and stopping; and results in an ability to maintain close compressor and turbine blade (bucket) clearance for greater component efficiency and high power output.

All three-turbine stages have precision-cast, long shank buckets (the individual airfoils on the compressor wheels are called blades, while those on the turbine wheels are called buckets). This innovation effectively shields the wheel rims and bucket bases from the high temperatures of the main gas stream. Turbine wheels are cooled by air extracted from the compressor discharge and 17th stages that is then ducted through the rotor bore to points of introduction at the wheel faces. Wheel space temperatures are monitored by thermocouples.

The turbine unit casings are split and flanged horizontally for convenience of disassembly. Compressor discharge air is contained by a separate, fabricated outer shell.

All three turbine stages utilize precision-cast, segmented nozzles. The second- and third-stage nozzles encompass a simplified arrangement, with the nozzles segments supported from stationary shrouds. This arrangement removes the hot-gas from contact with the turbine shell.

The MS-7001E gas turbine can be designed to operate on, distillate oil, or gaseous hydrocarbon fuel.

4. Hitachi Gas Turbine Generator design Data

The following table lists YANBU Gas Turbine Generator design data:

Altitude......Sea Level
Shaft Rotational speed......3, 600 rpm

Lubricating Oil Reservoir

Capacity......11,000l

Fuel..... Ethane gas / Distillate Oil.

Compressor stages.....17

Turbine Stages...... 3

Starting Means.....670 kW electric motor

Loading Time

Normal......20 minutes
Fast Load......9.5 minutes

Rated Load, Sales Gas at site (50 C)

Simple-cycle

Combined-cycle

Base56, 570 kW

55, 720 kW

Peak..... 62, 310 kW

61, 370 kW





Rated Load, Distillate oil at site (50 C)

Simple-cycle

Base..... 56, 170kW Peak...... 61, 710 kW Combined-cycle 55, 320 kW 60, 780 kW

Total GTGs Running Hours up to December, 2014

Gas Turbine Unit No.	GTG #1	GTG #2	GTG #3	GTG #4	GTG #5	GTG #6	GTG #7	GTG #8
Overall running	197,362	187,603	182,168	198,148	190,309	186,083	188,208	189,755







II. TECHNICAL REQUIREMENTS

1. General scope of services

MARAFIQ intends to go for GTG frame 7001E Full Unit Uprate, since all Gas Turbine Generator's rotors have reached to 200K. Replacement is also confirmed by two external consultants KEMA/ ATTS and General Electric.

The work to be performed under this contract consists of furnishing all labor, supervision, tools, equipment, technical and professional services, materials supplies and articles necessary to perform work involving "Full unit Uprate".

2. Engineering and design responsibilities

- g) The required professional Replacement shall include review the complete design, development, the final asbuilt drawings and other required documents necessary and related professional services in connection with the as specified herein, except as may be specifically excluded in the contract document.
- h) The engineering and design responsibilities, under this contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/ drawings by utilizing technical documents from the Owner's files.

3. Applicable codes and standards

- d) The contractor shall comply with the applicable parts of the following industry codes & standards as basis for all types of engineering & construction works.
- e) American Petroleum Institute API-616 for Gas Turbine.
- f) American Petroleum Institute API-687 for Rotor Repair.

4. Proposed Modification

Marafiq is considering replacement of complete Uprate parts in Turbine modification as a package for each Gas Turbine Generators (for GTG 1 to 8) to Improve Heat Rate – 8% Fuel/MW. The existing 56.2 MW Gas Turbine Generators Frame 7001E (for GTG 1 to 8) is Hitachi Manufactured, licensed from GE. Further, each of the two gas turbines is connected to one HRSG. The proposed modification consists of

Scope of Supply

The following is a list of modifications that are available to the subject units, based on the Configuration analysis performed in Appendix A. Each uprate is identified with a specific four-digit Sourcebook Code. Details of each uprate are shown Appendix B:

- A. C450 Reduced Camber IGV
- B. IGV angle increase to 86 deg.
- C. Shrouded Stator Blades (Stage 17 & EGV)
- D. Counter Bore Covers
- E. Nimonic 263 Transition Pieces
- F. Perimeter Cooled GTD-111 DS Stage 1 Buckets
- G. Stage 2 Buckets with Improved Cooling
- H. IN-738 Stage 3 Bucket
- I. HR-120 Stage 1 Shrouds with Spline Seals
- J. Improved Cooling Stage 1 Nozzle & Improved Cooling Stage 1 Nozzle Stage 1 Support Ring P.O. Box 190219







- K. GTD-222+ Stage 2 Nozzle & GTD-222+ Stage 2 Non-Pressurized Conversion
- L. GTD-222+ Stage 3 Nozzle
- M. Honeycomb Stage 2 Shroud
- N. Honeycomb Stage 3 Shrouds
- O. Stage 1 Shroud Abraidable Coating
- P. High Pressure Packing Brush Seals
- Q. Brush Seals for existing S2N + Tuning Pins
- R. No. 2 Bearing Brush Seaf
- S. Advanced Aero Stage 3 Nozzles
- T. Advanced Aero Stage 3 Buckets
- U. Exhaust Temperature Control Curve



b. Benefits

This uprate provides improved Heat Rate and increased output due to the increase in firing temperature and the reduction in the turbine wheel space cooling flow. Refer to each product descriptions for further details.

Additionally, since the material supplied is designed for 2055 firing temperature, the hot gas path inspection interval will remain at 24,000 hours. The combustion interval may be extended due to incorporating the Extendor Wear Kit system (24,000 hours for gas fuel/base load/dry or steam injection for NOx)

c. Performance Effects

With the modifications quoted in the proposal, the Output will be increased and the Heat Rate reduced, this will benefit the performance. Also the firing temperature will be increased according with the customer requirement, and the unit will be used the latest parts in current production.

Description	Code	Output (kW),% Change	Heat Rate(KJ/KWHr),% Change
GTD-222 S2N (non-press)	FS1P	0.8%	-0.3%
Improved Cooling S1N	FS2J	0.0%	-0.3%
Honeycomb S2S	FS2T	0.4%	-0.4%
Honeycomb S3S	FS2U	0.2%	-0.2%
HPP brush	FS2V	1.0%	-0.5%
#2 Brg. Brush	FS2X	0.3%	-0.2%
HR120 S1S with Spline Seals	FS2Y	0.7%	-0.3%
S2N Non-press. diaphragm & brush seal)	FS2Z	1.0%	-0.5%
S3N/S3B Advance Aero	FS4K/FS4L	1.0%	-1.0%
S1S Abradable coating	FS6A	0.5%	-0.5%
GTD-450 IGV's	FT5B	1.5%	-0.3%
IGV: Open to 86 deg	FT5B-B	0.4%	0.2%

Performance Basis

- ☑ ISO Conditions (15 deg. C Ambient Temperature, 60% RH, 1.013 bar)
- 100% Sales Gas Fuel
- Gas Turbine at Base Load

The Energy has confidence in the gas turbine performance improvements identified for individual uprate components. However, customers may not experience the rated performance benefit of an individual component upgrade if other components, either refurbished or third party, are replaced at the same time. Benefits associated with Energy improvement package to be assured without a complete audit of all of the

8.00 M

turbine's installed hot gas path components. In addition to replacement of parts, the parts need to be installed using recommended procedures to fully realize the rated performance benefit.

A. FT5B - C450 Reduce Camber High Flow IGV

The reduced camber high flow Inlet Guide Vane is a flatter, thinner Inlet Guide Vane designed to increase airflow. There are two modification kit options. The first includes only the vanes and the installation hardware. The second includes the vanes, the rack and ring, gears, and installation hardware.

The reduced camber, high flow inlet Guide Vane is directly replaceable with the original IGV's. The new airfoil design allows increased airflow. The new IGV's have higher reliability due to the use of a special stainless steel alloy, GTD-450. This material is precipitation-hardened, martensitic stainless steel that is improved over the Type 403 previously used.

These improvements include increased tensile strength, high cycle fatigue, corrosion fatigue strength, and superior corrosion resistance due to higher concentrations of chromium and molybdenum. Tests have shown that the uncoated GTD-450 gives better corrosion resistance than the coated Type 403s. Also new bushings help to prevent blade cracks due to binding of the IGV shaft.

If the actual ring and rack are not in good condition, and/or the turbine experience any VIGV seizing, they have to be replaced. The new gears and gear rack have been improved with a Zinc-Nickel plating to minimize seizing.

B. IGV ANGLE INCREASE TO 86°

The IGV angle can also be increased from the standard 84 degrees to 86 degrees with C450 IGV's. This will increase output ($\sim +0.4\%$) with a slight heat rate penalty ($\sim +0.2\%$).

Benefits

The design of the reduced camber high flow Inlet Guide Vane provides increased performance and corrosion and crack resistance.

Scope of Supply

The Reduced Camber, High Flow IGV Modification includes the following:

- IGV stator blades
- IGV arrangement

Including necessary bushings, springs and installation hardware.

Installation and modification documents

C. FS2B - Shrouded Stator Blades (Stage 17 & EGV)

The need to implement the 17th stage stator correction is attributed to aerodynamic vane stall that Occurs under certain unit operating conditions. Any time when a new stage 2 nozzles with GTD-222 is applied to the unit that has FXS 414 stage 2 nozzles installed previously or an open case modification is needed, it would result in change in cooling flow, which might have an affect on the seventeenth stage of the compressor. The root cause identified as separated flow, aggravated by counter-bore holes, violating S17 aerodynamic limits and leading to flow vibration failures as exposed counter-bores create airflow instability upstream and fractured airfoils found in the vicinity of counter bore holes.

The root causes of the S17/EGV distress could include the airflow turbulence from the counter bore holes of the inner barrel and some operational conditions such as Operation during periods of cold ambient temperatures, Operation at reduced load (with lower IGV angle, especially for Combined Cycle), Operation with water injection,





and Low BTU gas fuel. The counter bore hole covers reduce the airflow turbulence from the counter bore holes of the inner barrel and yield significant reductions in S17 & EGV 1/2 operational strain levels. This phenomenon can also be described as a measure of the incidence angle of the airflow across the Stator 17 vanes or as a ratio of the axial air velocity and the tangential wheel speed.

This phenomenon can also be described as a measure of the incidence angle of the airflow across the Stator 17 vanes or as a ratio of the axial air velocity and the tangential wheel speed.

To prevent this complex aerodynamic failure, the following configurations are available to install.

Shrouded 17th and EGV 1& 2 Vanes:

The compressor stator rear end modification consists of redesigning the airfoil and incorporating shrouded assemblies on the stage 17-stator blade, and both stages of the exit guide vanes. This modification alleviates aerodynamic vane stall and stabilizes the stator blades. Existing turbine unit hardware must also be Modified to accept the new shrouded assemblies. This includes removing, and modifying the compressor discharge casing inner barrel. Grooves must be machined into the inner barrel and an extended ring must be added to reduce the axial clearance between the barrel and the compressor rotor. The counter bore covers are also required when installing shrouded stator 17th and EGV 1&2 vanes.

D. COUNTER BORE COVERS

Compressor Pressure Ratio (CPR) control, IGV angle re-scheduling or Stage17/EGV1&2 Shrouded Vanes with slotted Inner Barrels may be required. Counter Bore Covers can be added to reduce to minimize heat recovery steam generator impact. The counter bore hole covers reduce the airflow emanating from the counter bore holes of the inner barrel and yield significant reductions in S17 & EGV 1/2 operational strain levels. In some cases, IGV restrictions are required with counter Bore covers.

New control Protection software modification-IGV reschedule for installed units, the preferred control protection is a minimum IGV angle versus ambient temperature control based on unit configuration, similar to that shown in Figure 2. For recent units with post-2001 Mk V controls, the control protection may be implemented by pressure ratio control.

Counter Bore Covers are highly recommended and should be installed. If the customer is not interested in the S17 & EGV Vanes + New Inner Barrel, then the unit will have to be operated restrictions.

If the unit is equipped with Shrouded vanes and slotted inner barrel, IGV angle reschedule will not be required anymore.

E. FR1D - Nimonic Transition Pieces

Nimonic 263 transition pieces were introduced in the early 1980s as components that will serve to increase maintenance intervals and to increase hot gas path life.

Technical Description

Nimonic 263 was introduced for service in transition pieces in the early 1980. It is a precipitation strengthened, nickel base alloy with high strength capability. Nimonic 263 has been successfully used in aircraft design gas turbines for over 25 years and has demonstrated superior creep life. The Nimonic 263 transition pieces are being coated with thermal barrier material, thereby reducing metal temperatures. On the MS7001, the Nimonic 263 transition piece has a redesigned body shape. The Nimonic transition pieces also include a redesigned aft bracket that reduces cracking at the bracket weld area by allowing the transition pieces are pieces are being coated that reduces cracking at the bracket weld area by allowing the transition pieces.

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The new transition piece offers superior creep strength and is best used in peaking applications where the fired hours are low with a high number of starts.

Benefits

This modification can allow for an increase in firing temperature (for MS7001 units). It will also contribute to increased reliability and lengthening of maintenance intervals.

Scope of Supply

- 1. Nimonic Transition Pieces
- 2. Transition Piece Arrangement (including bull horn brackets)
- 3. Installation and Modification Documents



F. FS4A - Perimeter Cooled GTD-111 Stage 1 Bucket

The Perimeter Cooled Stage 1 Bucket incorporates several design improvements to allow for operation at the higher firing temperature associated with the 7EA Advanced Technology Uprate. The directionally solidified (DS) GTD-111 buckets possess an oriented grain structure that runs parallel to its major axis and contains no transverse grain boundaries. The elimination of the transverse grain boundaries results in additional creep and rupture strength. The orientation of the grain structure provides a favorable modulus of elasticity in the longitudinal direction increasing fatigue life.

The new bucket-cooling scheme also includes a series of sixteen radial cooling holes located around the "perimeter" of the bucket. Thirteen of the cooling holes include "turbulators" on the internal surfaces of the cooling holes (from 0 to 80% of bucket span) to increase the efficiency of heat transfer from the bucket metal to the cooling air. The tabulators are STEM drilled (Shaped Tube Electrochemical Machining).

The buckets also incorporate a cored or hollow shank that more effectively provides air to the 16 cooling holes. This feature allows for more consistent control of the quantity of cooling air and reduces the risk of cooling holes becoming plugged during operation.

In addition to the improvements in cooling, the new bucket has a new airfoil profile. The new airfoil profile has been designed with heat transfer characteristics appropriate for operation at the higher firing temperature of the 7EA Advanced Technology Uprate. This included thinning of the leading edge and rotating the airfoil hub sections. With all of these improvements, the bulk metal temperature of the new first stage buckets operating at the higher firing temperature will be lower than the bulk metal temperature of the current buckets operating at the lower firing temperature. GT-33INPLUS is the standard coating applied to the buckets. For units that burn corrosive fuel, GT-29 INPLUS coating can be provided upon request.

Benefits

The Perimeter Cooled stage 1 bucket possesses an advanced cooling design that provides more effective cooling of the stage 1 bucket. The improved cooling allows the bucket to be used at extended life intervals for the higher firing temperatures associated with the 7E 2055 F Uprate.

With the new aerodynamic design of the Perimeter-Cooled 7E Stage 1 bucket, gas turbines can expect an increase in bucket life from 72,000 to 96,000 hours.

The estimated lives of these Stage 1 Buckets is 96,000 Hrs. Strip and recoat buckets at 48,000 HGPI and replace at 96,000 hours at 2055F Tfire.

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These buckets (and all the improved components) are fully interchangeable with previous designs as Complete kits.

Scope of Supply

This modification includes the following:

- First stage bucket kit
- Installation and modification documents

G. FS4B – E Stage 2 Bucket

The Improved Cooled Stage 2 Bucket incorporates several design improvements to allow operation at the higher firing temperature associated with the 7E 2055 F Uprate. The material for the new stage 2 buckets continues to be IN738.

The MS7001 bucket design includes ten smooth bore radial cooling holes, in lieu of the traditional eight smooth bore radial cooling holes, and an uncoated airfoil.

The MS7001 buckets are capable of achieving the estimated replacement intervals (three hot gas path inspections) at the uprate firing temperature. The new stage 2 bucket designs also include "cutter teeth" on the bucket tip shroud rails. These are designed to cut a slot in the honeycomb seal material on the Stage 2 shroud block with no metal transfer to the bucket. This will allow new shroud blocks with honeycomb seals to be installed (refer to FS2T).

Cutter teeth have been included on all stage 2 Frame 7E buckets produced since early 1996.

These buckets are suitable for units that do not have honeycomb stage 2 shrouds fitted.

Stage two buckets can be supplied with a Chromium Diffusion Coating, which is recommended for units burning heavy fuel oil. Please contact AE if this is required.

Benefits

The Improved Cooled Stage 2 Buckets possesses an improved cooling design that provides more effective cooling of the stage 2 bucket. The improved cooling allows the bucket to be used at the higher firing temperature associated the 7E 2055 F Uprate.

The redesigned bucket has a designed life expectancy of three Hot Gas Path Inspections (72,000 hours for gas only, dry, base loaded operation).

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Scope of Supply

This modification includes the following:

- Second stage bucket kit
- Installation and modification documents

H. FS2K - IN-738 Stage 3 Bucket

The latest stage 3 bucket design is made out of IN-738 material instead of U-500. The IN-738 material offers superior hot corrosion resistance in comparison to U-500 and also has outstanding strength at the high uprate temperature.

The new stage 3 bucket designs also include "cutter teeth" on the bucket tip shroud rails. These are designed to cut a slot in the honeycomb seal material on the stage 3 shroud block with no metal transfer to the bucket. This



will allow new shroud blocks with honeycomb seals to be installed (refer to FS2U). Since 1996 all new Frame 7EA Stage 2 and 3 buckets have been manufactured with cutter teeth on the bucket tip rails.

For MS7001EA, the IN-738 uprated bucket is dimensionally interchangeable with the existing bucket except the material changing from U-500 to IN-738. The MS7EA IN-738 bucket does NOT have the rotated airfoil.

- The Stage 3 Buckets without cutter teeth must be modified or replaced with cutter teeth buckets.
- 2. Current production MS7121 ship with IN-738 cutter teeth stage 3 buckets.

Benefits

This modification improves the third stage buckets parts lives for the higher firing, uprate temperatures.

Scope of Supply

This modification includes the following:

- 2 Stage 3 bucket kit
- Installation and modification documents

I. FS2Y – HR-120 Stage 1 Shrouds with Intersegment Cloth Seals

The new shroud includes a new spline seal arrangement that is designed to reduce leakage between shroud segments, the shroud designs include an interlocking labyrinth (or "pumpkin tooth") configuration at the intersegment interface to reduce leakage from the forward to the aft side of the shroud. A single, large spline seal (known as a "bus bar" seal) is arranged parallel to the flow path to inhibit leakage out of the shroud. Analysis and rig testing has shown that shroud intersegment leakage can be reduced significantly by changing from the labyrinth/bus bar design to a flat side face with multiple cloth seals to reduce both axial and radial leakage.

A spline seal is a strip of metal inserted into a groove on the side faces of each adjoining segment thus forming a barrier to leakage flow. These spline seals have historically been rectangular in shape. The Improved Stage 1 Shroud incorporates a cloth spline seal arrangement. A cloth spline seal is a GE-patented design where L605 metal wire is woven into a cloth and then wrapped around and spot-welded to a strip of X750 metal. The L605 (or Haynes 25) material provides wear resistance and has been used in floating seals and brush seals. X750 is the same material used in combustor hula seals. The cloth spline seals provide a more flexible, relatively compliant seal that can conform to changes in gap configuration between segments typically caused by thermal and aerodynamic

Loading of the shroud.

A "W" seal on the forward side of each shroud segment provides an improved seal between the stage 1 nozzle retaining ring and the shroud blocks. This is a thin metal strip with a "W" cross section that is inserted into a groove on the shroud forward side. It is compressed for the retaining ring when the nozzle is installed. It provides a positive sealing force and can comply with small changes in the relative position of the nozzle and shroud during operation.

The current production 7EA PG7121 units ship with an SS310 Stage 1 Shrouds with cloth seals for intersegment sealing. While the HR120 Stage 1 Shrouds with intersegment cloth seals are required for the 2055F Uprate (refer to Sourcebook FT5Q), this HR120 Stage 1 Shroud will not provide an incremental performance benefit over the SS310 Stage 1 Shrouds with cloth seals.

Benefits







For E Class turbines, the improved stage 1 shrouds provide improved LCF life while permitting the use of a onepiece shroud at the higher temperatures of the Advanced Technology Uprates. For all applicable units, the improved sealing features increase performance as tabulated below:

SBK Code	Combined Cycle		Exhaust Conditions		
	KW Output	Heat Rate	Exhaust Flow	Exhaust Temp	Exhaust Energy
	% Change	% Change	% Change	% Change	% Change
FS2 Y	+0.6%	-0.2%	0.0%	+4	+0.4%

Scope of Supply

This modification includes the following:

- Kit, stage 1 turbine shroud assembly
- Installation and modification documents
- If needed, control curve modification
- Add tuning pins

J. FS2J - Improved Cooling for Stage 1 Nozzle

The Improved Cooling, Stage one nozzle includes modifications to the sidewall cooling, a new impingement hole pattern on the core plug, a new pressure side cooling hole pattern, improved inner segment spline seals, and an improved seal. Improved sealing is achieved through application of an improved seal and spline seal arrangement. The hinge design originates from proven aircraft engine technology applied to today's heavy-duty gas turbines. The improved seal is created on the support lug with a new straight improved seal ridge. This results in an improved seal at the First Stage Nozzle/Support ring interface. This seal eliminates the potential leak path due to warping and distortion sometimes associated with the older curved support lug disengaging during operation. This straight improved seal requires a redesigned shorter tangential slot on the inner sidewall support lug. This new seal coupled with the offset of the support lug combine to create a 'hinging' action downstream from the retaining ring along the radial plane of the nozzle. Improved inner segment sidewall spline seals reduce leakage between nozzle segments. The second major design change incorporated into the improved cooling, stage one nozzle is the addition of a more efficient film-cooling pattern. This new design incorporates a sidewall cooling hole pattern that has been relocated to promote better coverage of the most commonly distressed area on the nozzle sidewall.

As determined by computer modeling and operational histories. The improvement in coverage pattern is achieved on current production nozzles by replacing the pressure side film holes with film cooling slots (as shown in the figure). The new slots are spaced more closely together and are combined with new cooling holes to the inter-vane space on the nozzle outer sidewall. The resulting improvement in exit conditions significantly increases the cooling efficiency of the airflow to the sidewall areas without increasing the overall airflow requirement.

- The nozzle retainer often distorts at the ring's aft face during disassembly and may require rework or replacement prior to reassembly of the unit. Consult with the GE Service Center performing the uprate for details during nozzle refurbishing.
- 2. Per TIL 1140-2R1, if customers uprate their 71 EA or 7/1B to E conversion, they need to replace the existing stage 17 stator vanes and EGV 1 & 2 with the new design. Down time during this Stage one Nozzle modification provides an opportunity to convert. Therefore this conversion is included as a necessary addition with this option.

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Benefits

The main benefit of this uprate first stage nozzle is the reduced nozzle distress at the sidewall by improved sidewall cooling and sealing design. This new improved cooling stage one nozzle provides significant increase in compressor ratio and reduces the heat rate of operating units especially when applying E style S1N to 7B and 9B units.

The gas turbine performance improvements identified for individual uprate components. However, customers may not experience the rated performance benefit of individual component upgrades if other components either refurbished or third party, are replaced at the same time. Benefits associated with any improvement package to be assured without a complete audit of all of the turbines installed hot gas path components. In addition to replacement of parts, the parts need to be installed using recommended procedures to fully realize the rated performance benefit. Special attention is required for the turbine stage 1 nozzle due to its significant impact on the overall gas turbine performance.

Scope of Supply

For the MS7001E the following should be added as needed:

- CURVED EXIT IMPELLER
- **☑ STAGE 17 ROTOR BLADES**
- COMPRESSOR ROTOR STUD ASSEMBLY

K. FS1P - GTD-222+ Stage 2 Nozzle

The second stage nozzle was redesigned in order to significantly reduce creep-related downstream nozzle deflection. Analysis over time has shown that units experiencing downstream creep deflection require additional monitoring leading to increased maintenance and repair costs. FSX-414 nozzles are subject to downstream creep deflection due to the cantilevered design of the nozzle, exposure to high temperatures, and downstream loading caused by axial pressure differentials across the nozzle and gas reaction forces. Because of the inherent creep resistance properties of the nickel-based alloy GTD-222+, the new nozzle replaces previous nozzles fabricate from FSX-414. The new GTD- 222+ second stage nozzle is also coated with an aluminide coating providing improved high temperature oxidation resistance.

Other improvements include changes to the second stage nozzle's internal core plug. The core plug modifications allow more efficient distribution of cooling air and reduce nozzle-cooling requirements. The resulting reduction in overall cooling airflow translates into increased turbine output and efficiency (therefore improving heat rate). Also, changes in chord length results in reduced stress levels and increased part life.

New tuning pins associated with this uprate in combination with core plug modifications, further reduce cooling air requirements and result in additional performance improvements in machines with air cooled second stage nozzles.

Stage 1 shroud blocks may be typically be re-used /Replaced against the Part Exchange programme.

NON-PRESSURIZED CONVERSION

With pressurized nozzle arrangement, this option includes air boxes and shop modifications to convert diaphragm design from pressurized to non-pressurized, thereby maintaining unit performance, minimizing leakage and ensuring suitable wheel space temperatures. It excludes the diaphragms, which are part of the base nozzle kit.





To optimize the unit performance with this change, Tuning pins for the first stage shroud and control curve adjustment are required in order to adjust the airflow.

The E-class turbine stage 2 nozzles were originally designed as a non-pressurized unit. The stage 2 nozzles had an air box and tube assembly welded at the inner sidewall that directed the flow of cooling air to the forward wheel space. In 1996, the air box assembly was removed, as well as the forward seal on the diaphragm. That configuration allowed for pressurization of the internal cavity of the diaphragm. It was originally thought that the removal of the forward seal and the open forward holes in the diaphragm would encourage the cooling flow to purge into the forward wheel space, thereby achieving the same effect as the air box assembly. However, a large amount of flow leaked through the gap between the aft diaphragm hook and the nozzle because of the increased

Diaphragm pressure results in high wheel space temperatures and less performance. The pressurized diaphragm was introduced on a 7EA uprate CM&U in 1997. With introduction of interstage brush seal to all units in 1999, higher wheel space temperatures and loss of performance are observed on all those units. A new design of non-pressurized nozzle, combines the best features of the past designs, is introduced to resolve the issues. It utilizes an air box assembly and tube to direct cooling air to the forward wheel space, while at the same time using the existing pressurized nozzle casting and diaphragm. The new design reinstates the forward diaphragm seal and maintains the aft tab on the nozzle to better control flow leakage around the aft hook of the diaphragm as shown in below.

Technical Document reference list

For more information, refer to the following GER publications:

- GER-3571H Performance and Reliability Improvements for Heavy-Duty Gas Turbines
- GER-3808B Uprate Options for the MS7001 Heavy-Duty Gas Turbine

For more information on related TIL's, refer to the following:

- TIL 1151-3 Second and Third Stage Nozzle Creep Deflection, Inspection, and Measurement Criteria
- TIL 1346 MS7001E

Benefits

The main advantage of the GTD-222+ second stage nozzle is the significant reduction in nozzle downstream stream creep deflection as a key life-limiting factor. Per GER 3571H, cooling airflow to the second stage nozzle is reduced on some units providing performance increases as detailed in the following table:

Frame	Combined Cycle		Exhaust Conditions		
	KW Output % Change	Heat Rate % Change	Exhaust Flow % Change	Exhaust Temp % Change	Exhaust Energy % Change

Scope of Supply

This modification includes the following:

- Second stage nozzle and diaphragm arrangement
- First stage shroud block modifications
- ☑ New tuning pins (MS 7001)
- ☑ Shroud block modification (MS7001)
- Installation and modification documents

L. FS1R – GTD-222+ Stage 3 Nozzle







The third stage nozzle was redesigned to eliminate the downstream nozzle deflection. The changes are similar to the material change of the second stage nozzle (reference FS1P). The chord length was extended to increase the airfoil's section modulus so that the bending stress level could be reduced.

The GTD-222+ material have replaced the FSX-414 due to the superior creep resistance property. GTD-222+ is a nickel based super-alloy that has a significant improvement in creep strength compared to FSX-414, a cobalt based super-alloy.

Bidder has to be demonstrating that the GTD-222+ nozzle has accumulated thousands of operating hours and has achieved a remarkable reliability record and customer satisfaction.

NOTES:

- 1. For more information, refer to the following GER publications:
- ☐ GER-3808B Uprate Options for the MS7001 Heavy-Duty Gas Turbine
- 2. For more information on related TIL's, refer to the following:
- ☑ TIL 1151-3 Second and Third Stage Nozzle Creep Deflection, Inspection, and Measurement Criteria

Benefits

The main advantage of GTD-222+ third stage nozzle is to eliminate the nozzle downstream creep deflection, a key life-limiting factor. The change of material of the third stage nozzle and redesign reduced stress levels and increased creep life.

Scope of Supply

This modification includes the following:

- THIRD STAGE NOZZLE ARRANGEMENT
- INSTALLATION AND MODIFICATION DOCUMENTS

M. FS2T – Stage 2 Shroud Honeycomb



Honeycomb seals are designed to reduce leakage associated with hot gases that flow around the tips of the buckets thereby improving both heat rate and output. In the past, clearances between the bucket shroud tips and the casing shrouds have been set based on expected transients that tend to close the clearances. The clearance had to be large enough to allow these transients to occur without permitting contact between the bucket tip and the shroud. As a result, the steady state running clearance is typically larger than needed from an efficiency standpoint. Honeycomb seals will allow contact between the bucket tip and the casing shrouds and will provide relatively tight clearances during steady state operation.

Strips of honeycomb material made of a high-temperature, oxidation resistant alloy are brazed between the teeth on the casing shrouds. "Cutter teeth" on the leading edge of the shrouded second stage bucket tip rails will "cut" the honeycomb material away when contact occurs during transients. This produces steady-state running clearances that are, on an absolute basis, no larger than the difference between the steady state and the transient clearances. The effective clearance is actually tighter than the absolute clearance since the resulting groove in the honeycomb provides a tighter labyrinth seal than could be obtained with solid materials. Honeycomb shrouds also reduce performance degradation by maintaining tighter clearances throughout the life of the shroud. Installation of honeycomb shrouds requires buckets with cutter teeth. Since 1996 all new Frame 7E Stage 2 and 3 buckets have been manufactured with cutter teeth cast into the bucket tip rails. While these buckets with cutter teeth can be used with conventional non-honeycomb shrouds, the incremental costs associated with replacing the shrouds is minimal in comparison to the performance gains that can be realizable.



Several methods have been employed to achieve the cutter teeth including casting in a 0.5 degree cant to the tips, machining a wedge leading edge shape and welding a wedge leading edge shape.

A process to weld cutter teeth to existing buckets has been developed for Frame 7/1E units. The process will require that buckets be removed from the rotor for modification. The full row of buckets does not need to be modified. As a minimum, 50% of the buckets in a given row will need cutter teeth to ensure proper performance of the honeycomb material. The modification may take several weeks to complete (actual cycle time will depend on shop loading and the number of buckets to be modified). Modifying spare buckets in advance of an outage will reduce outage downtime.

Notes

- 1. The Stage 2 Buckets without cutter teeth must be modified or replaced with cutter teeth buckets. For E Class units, refer to Sourcebook FS4B Second Stage Buckets with Improved Cooling for 71E Units.
- 2. A process to weld cutter teeth to existing buckets has been developed for Frame 7/1E units. Refer to qualified GE Service Shop for scope and cycle.
- 3. Current production MS7121 ship with Honeycomb Stage 2 and Stage 3 Shrouds.

For more information, refer to the following GER publications:

- ☐ GER-3808B Uprate Options for the MS7001 Heavy-Duty Gas Turbine
- GER-3571 Performance and Reliability Improvements for Heavy-Duty Gas Turbines.

Benefits

The honeycomb shroud stage 2 shroud design provides tighter operating clearances between the shroud and the rotating (cutter tooth) bucket tips than the previous labyrinth seal design. This design also produces an effective clearance that is actually tighter than the current absolute operating clearance since the resulting groove in the honeycomb provides a tighter labyrinth seal than is obtainable with the solid materials currently used. The honeycomb stage 2 shroud design provides the following performance gains:

Scope of Supply

The modification includes the following:

-STAGE 2 SHROUD BLOCKS (HONEYCOMB MATERIAL INSTALLED).

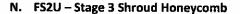
The following will be added as needed:

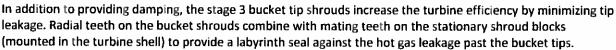
1) Stage 2 buckets with Cutter Teeth design

For E Class units, refer to the following Sourcebooks:

FS4B Second Stage Buckets with Improved Cooling for 71E units; OR

2) STAGE 2 BUCKETS MODIFICATION TO ADD CUTTER TEETH Refer to qualified GE Service Shop for scope and cycle.





Honeycomb seal technology has been proven in aircraft engine design to provide much tighter steady state and transient clearances. A typical design incorporates honeycomb material, which incorporates a small cell structure made of a high temperature, oxidation resistant alloy, which is softer than the bucket material. Strips of honeycomb material are mounted between the teeth on the casing shrouds. In the past, clearances between







bucket tips and shroud blocks were designed based upon expected transients that tend to close clearances. With the previous bucket/shroud block interface design, the clearances needed to be large enough to allow these transients to occur without permitting contact between the bucket tip and the shroud block (i.e. "rubs").

With the installation of the tighter clearance honeycomb seal design shroud blocks, the buckets must also be modified or replaced. "Cutter teeth" must be added to the shrouded tip bucket rails leading edge in order to "cut" the honeycomb material away if contact occurs during transient conditions.

The bucket seal teeth, which remain unharmed after cutting a passage in the honeycomb material, maintain a tight clearance. Since 1996 all new Frame 7E Stage 2 and 3 buckets have been manufactured with cutter teeth on the bucket tip rails. Several methods have been employed to achieve the cutter teeth including casting in 0.5 degrees cant to the tips, machining a wedge leading edge shape and welding a wedge leading edge shape.

This modification requires a new set of shroud blocks with the honeycomb seal material as well as a modified or new set of buckets with the cutter teeth design.

A process to weld cutter teeth to existing buckets has been developed for Frame 7/1E units. The process will require that buckets be removed from the rotor for modification. The full row of buckets does not need to be modified. As a minimum, 50% of the buckets in a given row will need cutter teeth to ensure proper performance of the honeycomb material. The modification may take several weeks to complete (actual cycle time will depend on shop loading and the number of buckets to be modified). Modifying spare buckets in advance of an outage will reduce outage downtime.

Notes

The Stage 3 Buckets without cutter teeth must be modified or replaced with cutter teeth buckets.

- ☐ Refer to Sourcebook FS2K, IN-738 Stage 3 Buckets for the latest offering of new stage 3 buckets
- ① Current production MS7121 ship with Honeycomb Stage 2 and Stage 3 Shrouds For more information, refer to the following GER publications:
- GER-3808B Uprate Options for the MS7001 Heavy-Duty Gas Turbine
- ☐ GER-3571 Performance and Reliability Improvements for Heavy-Duty Gas Turbines

Benefits

This design produces an effective clearance, which is actually tighter than the absolute clearance since the resulting groove in the honeycomb provides a tighter labyrinth seal than is obtainable with the solid materials currently used. The expected performance gain in output and efficiency due to the improved sealing characteristics of the honeycomb seals on new stage 3 shroud blades with new stage 3 buckets with cutter teeth is estimated to be:

Frame	Combined Cycle		Exhaust Conditions		
	KW Output	Heat Rate	Exhaust Flow	Exhaust Temp	Exhaust Energy
	% Change	% Change	% Change	% Change	% Change
71E/EA	+0.1%	-0.1%	0.0%	-1	- 0.1%

Scope of Supply

The modification includes the following base kit:

- ☑ STAGE 3 SHROUD BLOCKS (HONEYCOMB MATERIAL INSTALLED)
- ☑ INSTALLATION AND MODIFICATION DOCUMENTS

The following will be added as needed:

Stage 3 Buckets with Cutter Teeth design







☑ Refer to Sourcebook F\$2K, IN-738 Stage 3 Buckets
OR

DI Stage 3 buckets modification to add Cutter Teeth

Refer to qualified GE Service Shop for scope and cycle.

O. FS6A - Abradable Coating Gen 3



The Stage 1 Shroud Blocks can be coated with an abradable coating on the inner diameter surface. The abradable coating is designed to preferentially wear away in the event of a bucket tip rub, greatly reducing wear on the bucket tips. It also allows tighter clearances between the bucket and shroud leading to performance improvements. The abradable material is temperature limited to "E" class turbines.

The abradable coating on the stage 1 shroud allows for improved airflow control. Clearances between static and rotating components allow for airflow leakage with no performance benefit from the air. The clearance between the static and rotation components can be influenced by several factors. Transient thermal growth, rotor alignment, rotor sag, and turbine shell out of roundness contribute to clearances between the stage 1 bucket and the stage 1 shroud. The abradable coating compensates for these factors to minimize the clearance. The improved clearance and associated reduction in tip leakage creates a performance benefit. The abradable coating is a metal with an integral material. This material was chosen based on its resistance to oxidation, abradability, erosion resistance, thermal shock resistance, as well as other properties that allow it to perform its intended function for an extended period of time. The integral material is relatively soft so that there is effectively a porous metal on the shroud block surface which will wear instead of the bucket tips. Prior to application of the abradable coating, the shroud block is blasted to remove the 6 mil of hard coating typically applied by the shroud block manufacturer. The abradable coating on shroud blocks is not applicable to tip-shrouded stage 1, stage 2 or 3 buckets, and is not offered for tie-wire stage 2 buckets.

The Gen3 abradable coating product provides an abradable coating that aligns with GER3620 S1S repair/replace intervals for 7EA units. The goal of Gen3 abradable, patterned coating is to improve turbine performance in three ways, and maintain the performance as much as possible during a HGP interval as defined in GER3620.

First, the application of the coating physically reduces the 1R clearance between the S1S and S1B tip. The reduction in clearance is the result of the abradable coatings function to be rubbed by the bucket during operation and reduce the clearance without damage to the bucket tip. Secondly, field data suggests rubbing of the shrouds is typically not uniform in the circumferential direction that in many cases the S1S is either lightly rubbed or not at all during operation. This is due to casing out-of-roundness causing some shrouds to move inward and others outward relative to the bucket tip resulting in greater rub depth or no rub at all. The abradable coating to ensure rub engagement throughout the casing can compensate for this out-of-roundness condition. Thirdly, the patterned abradable coating ridgeline that duplicates the bucket chamber-line is an optimizing pattern on the surface of the shroud that could provide additional aerodynamic benefits since the pattern inhibits the flow over the bucket tip, reducing tip leakage losses, which translate into additional turbine performance gains. However, this program will not attempt to quantify any potential aerodynamic benefit due to patterned coating.

The Gen3 coating, based on a proven ceramic, was chosen because on its resistance to oxidation, erosion, and thermal shock thereby allowing it to perform its intended function for an extended period of time. This coating is more abrasive than the previous Gen0 coating, and uses a pattern to effectively reduce the volume of coating that is removed during a rub, and minimize wear of the bucket tips. Figure 1 below shows the pattern and cross-section of the Gen3 ceramic coating.

Abradable coating can only be applied on shroud blocks in good condition.

Benefits

The abradable coating on the Stage 1 shroud blocks will increase turbine section efficiency for increased opput power and improved heat rate.



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SBK Code	Combined Cycle		Exhaust Conditions		
	KW Output	Heat Rate	Exhaust Flow	Exhaust Temp	Exhaust Energy
	% Change	% Change	% Change	% Change	% Change
FS6A	+0.2%	-0.2%	0.0%	-2	-0.2%

Scope of Supply

This modification includes the following components:

Qtv

Service shop modification to apply Abradable Coating Only 1

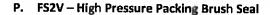
Note: Shroud Blocks must be purchased separately.

Installation Activity Required (Not Included in the Scope of this Proposal)

Send new S1S to the Service shop for application of the coating.

Site Information

No particular information needed from site in order for this modification to be engineered correctly.



The seal between the compressor discharge casing inner barrel and the compressor aft stub shaft is commonly referred to as the high-pressure packing (HPP). The HPP is designed to regulate the flow of compressor discharge air between the stationary inner barrel and the compressor rotor aft stub shaft into the turbine first forward wheel space. The clearance between the seals on the compressor discharge casing/inner barrel and the compressor rotor aft stub shaft controls the flow through this area. Some of this bypass airflow is required for cooling the turbine first forward wheel space; however, the current flow is excessive. Controlling this bypass airflow to the minimum levels required for cooling increases the amount of air available to perform work in the cycle.

This option consists of replacing the existing labyrinth tooth and seal arrangement with a more effective brush seal element. With this option a new inner barrel with a new brush seal are installed.

Notes

- Many recently shipped units include a honeycomb seal in the high pressure packing area. For these new
 machines a honeycomb seal design (similar to the design for stage 2/3 honeycomb shrouds FS2T/FS2U) is
 utilized on the high-pressure packing design and comprises a redesigned inner barrel and compressor aft stub
 shaft combination.
- 2. Recent brush seal field and factory tests have shown the brush seal to be superior over the honeycomb seal
- 3. When considering an HPP brush seal uprate for MS7001EA customers, unit configuration must be checked for honeycomb or labyrinth configuration. Units with factory installed honeycomb seal will need a new inner barrel complete with combination honeycomb and brush seal assembly. Units with labyrinth seal will only need new inner barrel and brush seal assembly.
- 4. This option will supply a new inner barrel that has been redesigned for installation of the brush seal. Existing (used) inner barrels should not be modified. The performance benefits of the brush seal/inner barrel system will be compromised.

Benefits

Rub-tolerant brush seals are designed to withstand rubs and maintain clearances in this critical sealing area. Metallic brush material is used in place of one of the labyrinth teeth on the inner barrel. Since the clearance between the brush seal and the rotor is reduced relative to the design clearance used with labyrinth tooth packing, there will be an increase in performance relative to a new labyrinth tooth seal. Performance gains the HPP brush seals are tabulated below.



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In addition, with brush seals at the high-pressure packing, the unit will be able to sustain these initial performance levels over an extended period of time because a rub will not increase the clearance. Because of the inherent flexibility of brush seal bristles, the seal is able to maintain contact on the rotor surface even after radial excursions. The brush seal bristles are simply displaced during the excursion and, then, return to their position once the transient condition has passed. Labyrinth seals would rub under similar excursions introducing higher leakage beneath the labyrinth seal, resulting in a significant performance loss for the unit. On a typical unit, a 20-mil rub translates into a loss in performance (approximately 1.0% output and 0.5% heat rate). Rubs greater than 20-mil are not uncommon. Hard facing of the turbine rotor in the HPP area is also not required.

Frame	Combined Cycle		Exhaust Conditions		
	KW Output % Change	Heat Rate % Change	Exhaust Flow % Change	Exhaust Temp	Exhaust Energy % Change
				% Change	
71E/EA	+0.6%	-0.2%	0.0%	-2	-0.2%

Scope of Supply

The modification includes the following:

- Brush Seal Assembly Inner Barrel
- **Installation Documents**

Q. FS2Z - Intersegment Brush Seal Stage 2 Nozzie



Brush seals for High Pressure Packing (FS2V) and #2 Bearing (FS2X) applications are also available and have been installed in a number of units. Each option uses the same design philosophy of installing brush seals within a labyrinth seal to maintain sealing if the brush seal should happen to fail. Interstage brush seals are inserted into a slot machined on the new diaphragm and replace one of the labyrinth teeth. Each brush seal option uses brush seals that have been specially designed for the application to take into account the location's operating conditions. These interstage brush seals are required to endure larger radial excursions. Therefore, this option's brush seals include a pressurized balance feature that reduces hysteresis effects that occur when the bristles are displaced radially during an excursion. Brush seals are comprised of a pack of fine metallic wires (or bristles) held in a frame. Simple designs have been used for basic sealing applications for a number of years. Recently, advanced designs have become prevalent in aircraft engine and industrial gas turbines. In these applications, brush seals are typically used as replacements or additions to labyrinth seals that are not maintaining their desired sealing levels, especially after a number of transient radial excursions. Because of the inherent flexibility of brush seal bristles, the seal is able to maintain contact on the rotor surface even after radial excursions. The bristles are simply displaced during the excursion and, then, return to their position once the transient condition has passed. Labyrinth seals would rub under similar excursions introducing higher leakages beneath the labyrinth seal. The brush seals also maintain a pressure gradient across the bristle path while minimizing leakage through the bristle pack. In testing, the sealing efficiency of a single brush is found to be about 10 times that of a labyrinth seal under similar conditions. A brush seal can easily accommodate misalignment normally not tolerated by labyrinth designs; and wear is also tolerable over longer hours of operation.

The current Stage 2 Nozzle without Brush Seals and gives the typical cross section showing where the interstage brush seal is being applied in the second stage turbine nozzle arrangement.

For 71E cooling for this configuration is controlled by means of a tuning pin inserted into either the forward or aft side of the first stage shroud. Depending on the size of the diameter of the lower portion of the pin, more or less air can be put into the system.

Notes

 Existing diaphragms cannot and will not be modified to the interstage brush seal configuration due to possible warping that occurs during service. This kind of warping would not allow for the tight tolerances needed when



installing the brush seal. No existing diaphragms will be reworked. Application of interstage brush seals will require a new diaphragm if the existing nozzle is to be reused. This work must be performed at GE certified service shop.

2. Existing GTD222 nozzles can be used and retrofitted with a new diaphragm brush seal combination, if they are deemed useable.

Benefits

The main advantage of the Second Stage Brush Seal is the reduction of flow leakage between the diaphragm and the turbine rotor into the stage 2 forward wheel space area.

Frame	Comb	Combined Cycle		Exhaust Conditions		
	KW Output	Heat Rate % Change	Exhaust Flow % Change	Exhaust Temp % Change	Exhaust Energy % Change	
	% Change					
7EA	+0.7%	-0.2%	0.0%	+1	+0.1%	

Scope of Supply

NECESSARY ADDITIONS

One of the following must be chosen:

New Stage 2 Nozzle (non-pressurized) with Brush Seals

New Stage 2 Nozzle with Interstage Brush Seal

First Stage Shroud Tuning Pin Arrangement

2) New Diaphragm with Brush Seals for use with Existing Nozzle

Brush Seal for existing GTD-222 non-pressurized Stage 2 Nozzles

First Stage Shroud Tuning Pin Arrangement

The following must be added as needed:

- Conversion to non-pressurized diaphragm design (if needed refer to FS1P for details)
- New pumpkin tooth shrouds (if needed)
- New HR120 cloth seals shrouds (if desired refer to FS2Y for details)

R. FS2X - Number 2 Bearing Brush Seals

Brush seals in the #2 bearing enhance performance by reducing leakage past the #2 bearing air seals. Since any air that leaks past these seals into the bearing housing does not perform additional work in the turbine, any reduction in this flow will result in an increase in performance.

Technical Description

This option will utilize brush seals in two of the air seals in the #2 bearing housing. Since the brush seals provide tighter clearances than the original labyrinth seals the leakage flow into the bearing housing is reduced. This leakage flow is typically vented to exhaust and therefore does not perform useful work in the system. By reducing the leakage, the brush seals result in an improvement in performance, both in output and heat rate.

Brush seals are comprised of a pack of fine metallic wires (or bristles) held in a frame and are typically used as replacements or additions to labyrinth seals that are not maintaining their desired sealing levels, especially after a number of transient radial excursions. Because of the inherent flexibility of brush seal bristles, the seal is able to maintain contact on the rotor surface even after radial excursions. The bristles are simply displaced during the excursion then return to their position once the transient condition has passed. Labyrinth seals would rub under similar excursions introducing higher leakage beneath the labyrinth seal resulting in a significant performance loss for the unit. The brush seals also maintain a pressure gradient across the bristle path while minimizing leakage





through the bristle pack. In testing the sealing efficiency of a single brush is found to be about 10 times that of a labyrinth seal under similar conditions. A brush seal can easily accommodate misalignment normally not tolerated by labyrinth designs; and wear is also tolerable over longer hours of operation.

The #2 Bearing Brush Seal should be installed in conjunction with the HPP brush seals (see FS2V) to maximize performance gains.

Technical Description Notes

- 1. Existing air seals cannot be modified for this option. New air seals with brush seals and installation hardware are provided as part of No. 2 Bearing Assembly
- 2. To maximize performance gains for all units the installation of #2 Bearing Brush Seals should be considered simultaneously with Sourcebook FS2V HPP Brush Seal
- 3. For the 71EA units, the addition of the #2 Bearing Brush Seal will require that the current production R17 rotor compressor blades be installed during the upgrade outage unless the unit is already configured with the Gen1, Gen3-678 Hz or Gen3-squealer tip blades as described in TiL1346- Refer to Sourcebook FW3V for replacement 71EA rotating compressor blades
- 4. For more information, refer to the following GER publications:
- GER-3808B Uprate Options for the MS7001 Heavy-Duty Gas Turbine
- GER-3571 Performance and Reliability Improvements for Heavy-Duty Gas Turbines

Benefits

- 1. The brush seal maintains tighter clearances than the previous labyrinth design. The expected performance gain due to the improved sealing (reduced leakage) characteristics due to the brush seal design at the #2 bearing is estimated in the table below
- 2. The brush also provides a much better seal interface over time. In the event of a rub, where the brush seal might contact the compressor aft stub shaft, the seal bristles will displace (bend) and then return to its normal position once the rub transient has ended. A similar transient rub on the current labyrinth design would result in damaged teeth, resulting in a less effective seal and a steady-state performance loss. The new brush seal design will be significantly less susceptible to wear, resulting in a significant reduction in performance degradation.
- 3. The gas turbine performance improvements identified for individual uprate components. However, customers may not experience the rated performance benefit of individual component upgrade if other components either refurbished or third party, are replaced at the same time. Benefits associated with any improvement package to be assured without a complete audit of all of the turbines installed hot gas path components. In addition to replacement of parts, the parts need to be installed using recommended procedures to fully realize the rated performance benefit.

Frame	Combined Cycle		Exhaust Conditions		
	KW Output % Change	Heat Rate % Change	Exhaust Flow % Change	Exhaust Temp % Change	Exhaust Energy % Change

S. FS4L – Improved efficiency S3B Aero Design







The improved airfoil design on the Advanced Aero Stage 3 Bucket creates a more favorable incidence angle to the exhaust frame strut. This substantially reduces recirculation, which can lead to turning vane failure. The high efficiency airfoil is significantly thinner from hub to pitch and has a closed airfoil throat reducing stage losses and improving efficiency.

The latest stage 3 bucket design is made out of GTD-741 material instead of IN-738 and offers similar hot corrosion resistance and outstanding strength at the high uprate temperature.

The Advanced Aero Stage 3 Bucket design also includes "cutter teeth" on the bucket tip shroud rails. The tip shrouds are re-scalloped for the new airfoil profile. The cutter teeth are designed to cut a slot in the honeycomb seal material on the stage 3 shroud block with no metal transfer to the bucket. This will allow new shroud blocks with honeycomb seals to be installed (refer to FS2U). Since 1996 all new Frame 7E/EA, and 9E Stage 2 and 3 buckets have been manufactured with cutter teeth on the bucket tip rails.

For MS7001A-EA, the advanced aero uprated bucket is dimensionally interchangeable with the existing bucket.

The preferred approach is to pull the rotor and replace or machine the third stage shrouds. However, it is possible, but not recommended, to change the shrouds without pulling the rotor. The following is a list of all possible options:

Rotor is removed. The recommended approach is to machine the exhaust frame and change or machine the shroud blocks. The exhaust frame forward inner face has to be machined back due to an interference problem when trying to pull the rotor. The exhaust frame machining allows for direct removal of the turbine rotor with new stage 3 buckets.

Machining of the exhaust frame is accomplished by a boring bar arrangement. The same boring bar can cut both the exhaust frame and the shroud blocks. The boring bar consists of two spider assemblies to support the boring bar bearings. It uses a hydraulic motor to turn the cutting head and a worm gear drive assembly to axially position the cutter. The spider supports are mounted in the #2 bearing housing and the inner exhaust frame.

Notes

The Stage 3 Buckets without cutter teeth can be modified or replaced with cutter teeth buckets. The Advanced Aero buckets can be supplied with P16C-AG3 coating. Please contact Application Engineering if this is required.

For more information, refer to the following GER publications:

GER-3808B "Uprate Options for the MS7001 Heavy-Duty Gas Turbine"

GER-3571 "Performance and Reliability Improvements for Heavy-Duty Gas Turbines".

Benefits

- 1. New 3D Aerodynamic High efficiency airfoil and bucket tip shroud are better balanced with extended to eliminates bucket near-hub airflow separation, reduces hub mach number, reduce stresses, improve durability and maximize creep
- 2. Reversed vortex design improve aerodynamics of bucket resulting in better bucket reaction and improve angle of attack distribution of exhaust frame strut incidence angle existing bucket for better diffuser inlet swirl profile for pressure recovery and reduces exhaust turbulence and maintenance on exhaust diffuser turning vanes
- 3. Re-scalloped conical bucket tip shroud fillet increases tip shroud engagement and covers airfoil throat to reduce stage losses and improved stage efficiency.
- 4. Output and Heat Rate improvement is available when used with advanced aero stage 3 nozzle (Ref. FS4K).
- 5. Advanced Aero design bucket kit is interchangeable with old parts and offers customer flexibility in mixing & matching complete sets of S3B.

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T. FS4K – Improve efficiency S3N Aero Design

The third stage nozzle was redesigned to improve aerodynamic performance. On the new airfoil, the inner and outer sidewalls are modified but the airfoil profile tolerances and wall thickness tolerances are the same. The flow path definition remains the same and the new nozzle design allows the use of the old machining fixtures in the hot gas path. There is also no reduction in transactional or contractual repair/replace intervals. See the Figure FS4K-1.

Dimensionally, the redesigned nozzle is interchangeable with the existing GTD-222 nozzle. The latest stage 3 nozzle design is made out of GTD-222+ material instead of GTD-222, which offers similar creep resistant properties.

Notes

For more information, refer to the following GER publications:

- GER-3808B Uprate Options for the MS7001 Heavy-Duty Gas Turbine

For more information on related TIL's, refer to the following:

- TIL 1151-3 Second and Third Stage Nozzle Creep Deflection, Inspection, and Measurement Criteria

Benefits

The redesigned airfoil will reduce stage losses and improve stage efficiency. When used in combination with the advanced aero stage 3 bucket (refer to FS4L), the Advanced Aero Stage 3 nozzle provides the following performance gains.

Frame 71 EA	Combined Cycle		Exhaust Conditions		
	KW Output % Change	Heat Rate % Change	Exhaust Flow % Change	Exhaust Temp % Change	Exhaust Energy % Change
ISO Day (59 F)	+0.4%	-0.4%	0.0%	-5	-0.6%
Hot Day (100 F)	+0.3%	-0.3%	0.0%	-4	-0.5%
Cold Day (0 F)	+0.5%	-0.5%	0.0%	-7	-0.7%

U. FT7J – Exhaust Temperature Control Curve

The exhaust temperature control curve(s) provides for consistent operation of the gas turbine across the operational envelope. When new gas turbine hardware is installed, there may be system performance improvements. If that is the case, the control curve must be revised to yield the expected performance. Additionally, some modifications may require changes to ensure proper operation of the unit. Finally, on some occasions the control curve is changes to manage the performance envelope.

Technical description

Gas turbine operation is managed by a sophisticated control system. While the control laws may be somewhat complex, the general theory of how a gas turbine is controlled is rather simple. There are a few common "knobs" which control operation. IGV and fuel flow are the two most basic knobs. IGV controls the compression system (airflow, etc.) while fuel flow sets the combustion temperature rise. The control curve synthesizes these basic knobs. A control curve must use reliable engine instrumentation to manage the engine operation. Thus, GE typically uses exhaust temperature control curves. The exhaust temperature is correlated to the compressor pressure ratio (or in some older models to the compressor exit pressure).





From time to time, it becomes necessary to revise the control curve. Typically this occurs when new hardware, particularly uprate hardware, is installed in the unit. The exhaust temperature control curve is revised to maintain firing temperature profile across the operating range.

The operational envelope of a GE gas turbine typically includes a large ambient temperature range. To accommodate operational differences in this temperature range, a segmented control curve is sometimes used. These segments are referred to as "pieces". Thus, GE controls may use one-piece, two-piece, three-piece, or even six-piece curve. The combustion type, frame size, control system, etc. dictate how many segments are used to achieve an optimum result.

Revisions to control curves typically maintain the same number of segments before and after implementation.

There are potentially several control curves in a unit control system: base load, part load, peak load, and backup control curves. A unit may have one or more of these curves depending upon configuration.

Additionally, if a unit currently operates with diluents injection for NOx control or power augmentation, or has any other operational parameters dependent on the control curve, these schedules and parameters will be updated on a unit-by-unit, as needed, basis. The determination of exactly what is needed is typically made at the time of the actual revision of the control curve, and does not affect the price or scope of this article.

Benefits

The benefits of a revised control curve can be increased output generating capability, reduced emissions, improved compressor surge protection, and/or improved unit degradation management. These benefits can be realized with the installation of other hardware modifications and uprates resulting in an economical, environmentally friendly, and safe operating configuration for the customer.

The control curve benefits are contingent upon several factors. Predictions are based on known configuration data and operating data. Deviations from the assumptions can result in variations in predicted to actual performance.

5. Acceptance Criteria

Operation and test run of each GTG's with Uprate parts in Turbine modification, to ensure the each Gas Turbine Generators (for GTG 1 to 8) to Improve Heat Rate – 8% Fuel/MW.

And the bidder shall take dismantled Part from modification of the Uprate and Available Capital Spares from Marafiq Ware house in the Parts Exchange Programme.







SECTION – IV G REWINDING OF GENERATORS FOR GTG UNITS 1-7







I. Technical requirement

1. Introduction

Power & Water Utility Company for Juba I and Yanbu (MARAFIQ) is a Saudi Joint stock company established by Royal Decree to serve for the utilities requirement in the Industrial City of Jubail and Yanbu.

Marafiq is responsible for the Operation and Maintenance of existing facilities related with power & water utility systems and development, and expansion of these utilities systems which comprise of power generation, transmission and distribution, sea water cooling supplies system, desalinated water (potable and process water), production and distribution, sanitary and industrial waste water collection and treatment.

2. Project Description

The project describes the requirements for rewinding of a power generator coupled with GTG Unit Nos. 1 to 7, Frame-7E GTGs.

The Manufacturing serial numbers being provided for easy reference of all eight (8) Hitachi generators, coupled with Frame-7E Gas Turbines Generator, with the coil insulation class as F, are as follows;

Mfg. No. 163661-1, 163681-1, 163701-1, 163721-1, 163741-1, 163761-1, 163781-1, 164201-1.

3. Project Objective

The objective of the project is to enhance the Generator Efficiency and to Restore the Generator to asmanulactured condition.

Contractor shall carry out complete design verification for the generator windings and the Hydrogen cooling system, to ensure whether the generator is capable of delivering an additional output on a continuous basis, due to the possibility of uprating the Gas Turbine.

Contractor shall provide the maximum generator performance data at 50 °C ambient temperature and Hydrogen pressure of 2.1 Kg/cm², and shall conduct study to verify whether the generator and Main Transformer 13.8/115 Kv can handle additional 8% increased unit output by using the uprated material for the turbine (estimated as an additional output of 4.4 MW above the rated base load).

Contractor shall submit the report of the design verification study with recommendation, to MARAFIQ for approval, prior to the re-winding work.

This project is critical and needs to be implemented in order to guarantee availability of the supply from GTG Units 1 to 7 for the succeeding years.

4. Project Location

This project is related to the MARAFIQ facilities complex in the Industrial City of Yanbu which is located at latitude of 24° 00'N, and longitude of 38° 10'E. It is relatively flat, rising 10m from the shoreline to the regional highway, which is the northeast boundary of the City development. The works of the project shall be located within the complex.

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5. Description of Work

The scope of work under this contract includes supply of all labor, materials, supervision, tools and consumables for rewinding of stator and rotor including replacement of retaining rings.

Also, Contractor shall carry out complete design verification for the generator windings and the Hydrogen cooling system, to ensure whether the generator is capable of delivering an additional output on a continuous basis, due to the possibility of uprating the Gas Turbine.

Contractor shall provide the maximum generator performance data at 50 °C ambient temperature and Hydrogen pressure of 2.1 Kg/cm², and shall conduct study to verify whether the generator and Main Transformer 13.8/115 Kv can handle additional 8% increased unit output by using the uprated material for the turbine (estimated as an additional output of 4.4 MW above the rated base load).

It also includes inspection, testing & commissioning and post commissioning performance monitoring of the unit after rewinding. The entire work shall be carried out at site by using the materials, services and parts manufactured or approved by the OEM (M/S Hitachi Japan).

5.1 Project Procedure

The Contractor, prior to start of work on the project, shall prepare and submit project procedure regarding; communication between all parties, schedule of activities, project documentation, safety practice record keeping and construction for MARAFIQ approval.

5.2 Equipment and Materials

The Contractor shall be responsible to supply all renewable parts, tools and consumables, assembly parts and special tools, general tools and facilities required to complete the job as lump sum basis without any disturbance to the Marafiq business.

Unless otherwise expressly provided herein, all materials and equipment shall be new and shall conform to the specifications, drawings, and other descriptions as set forth in this contract or provided by Contractor and approved by the MARAFIQ; and where not specified, such materials and equipment shall be of the most suitable grade of their respective kinds for their intended use.

- A. Bulk Materials Take Off
 - An approximate list of bulk materials and equipment to be supplied by the Contractor shall be provided with its technical proposal. The Contractor shall however, prepare and submit detailed bill of quantities to complete the work subject to MARAFIQ approval.
 - The Contractor shall submit documents, catalogues and commercial information for materials to be supplied subject to MARAFIQ approval, prior to ordering.
 - 3. The Contractor shall be responsible to provide any additional materials as required, due to change in construction drawings with the permission and prior approval of the MARAFIQ

5.3 Project Control & Coordination

The delivery time of contracted parts and materials for this project shall be well-coordinated with the overall project schedule and to meet the requirements of Power Generation Department.







5.4 Quality Assurance

The Contractor is fully responsible for the quality of his work, which shall conform to the requirement of the contract. Adequate facilities shall be provided conducive to the achievement of quality work. Assigned personnel shall be sufficient in numbers to maintain schedule and shall have technical qualifications, experience, and knowledge of work at a level with their peer.

5.5 Reference Documents

- A. Exciter Construction Details.
- B. Generator Spec. Sheet.
- C. Generator Construction Details
- D. Outline GA Dwg. For Generator.
- E. Rotor Details

5.6 PROJECT EXECUTION

5.6.1 Stator Rewinding Works as minimum

- A. Replace Stator coils (top bar and bottom bar).
- B. Replace Stator wedges, RTD, slot fillers.
- Replace Intermediate rings, end coil support rings, connection rings, etc.
- D. Check stator frame, stator core, stator core clamping (stator end plate). If the surface of stator core is found damaged, counter measures shall be discussed and determined.
- Main leads for line and neutral shall be reused.
- F. The stator rewinding work shall be carried out at site.
- G. The original stator coils and coil end support shall be disassembled.
- H. In order to confirm the integrity of stator core, EL-CID test shall be carried out.
- 1. The stator coils shall be rewound by new coils and new support.
- Stator coils and connection rings shall be connected by silver brazing.
- K. Drying out and spraying finishing varnish shall be performed.

5.6.2 Rotor Rewinding Works as minimum

- A. Replacing of Interpol connectors, series connectors, field leads, damper rings, turn insulations, slot armors, end spacer blocks and creep age blocks.
- B. The rotor rewinding work shall be carried out at site.
- C. The original rotor coils (field coils), old retaining rings, and old collector rings shall be disassembled.
- D. In order to confirm the integrity of rotor, the non-destructive inspection such as PT will be carried out for the rotor body, fan vanes, and so on.
- E. The rotor coils shall be rewound by re-insulating original rotor coil conductors.
- F. New coil wedges, new retaining rings & retaining ring insulations (retaining ring material will be changed from 18Mn-5Cr to 18Mn-18Cr as per Hitachi) and new collector rings shall be installed.
- G. All relevant electrical tests on rotor and stator.
- H. The existing rotor body, rotor coil conductors, fan vanes, AC exciter and HFG (High Frequency Generator) will be reused. If rotor body and fan vanes are found to be damaged seriously, countermeasures will be discussed and determined.
- AC exciter and HFG (High Frequency Generator) will be checked and tested by the contractor for the
 reliability of operation and if found unreliable the contractor shall provide recommendations for
 having these auxiliaries as reliable with the main unit.



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5.6.3 Generator Repair/Rewind Processes as minimum

Keeping an accurate written record of each repair is essential.

A. Preliminary Inspection

- 1. Generator nameplate(s) data Record all the data on the nameplate. Remember that there may be more than one nameplate.
- 2. Results of external inspection Provide results of external inspection (general condition, sign of overheating, bearing seizure, parts missing, damaged, repaired or replaced).
- Customer input Get input from the Marafiq about the generator (operating environment, driven equipment, hours/day runs, loading, frequency of starting, type of starter, if rewound before, how long operated since new, etc.).

B. Dismantling the generator

- 1. Terminal box layout and connections
 - a. Records markings on both winding leads and terminals.
 - Record positions of any links between terminals (make sketch).
 - c. Check that insulation on winding leads immediately adjacent to terminals does not show any signs of overheating (discoloration or brittleness). If it does, replace the leads.
 - d. Confirm that all terminals are firmly crimped or brazed to winding leads.
 - e. Record size and type of lead wire.
 - f. Record lug size and style.
- Orientation of end bracket and bearing caps End brackets and bearing caps should be
 installed in exactly the same positions as originally fitted. Therefore, indelibly mark all end
 brackets and stator frames at both ends of the generator before dismantling the generator.
- 3. Bearing sizes, types and clearances Always fit new bearings of the same type as those removed.
- Axial position of rotor relative to stator (drive end or opposite drive end) The rotor should be centered axially. Please note the position of axial thrust washer when dismantling the generator.
- 5. Orientation of shaft with respect to the main terminal box Document the mounting position of the shaft in relation to the leads.
- Careful rotor removal to prevent damage to air gap surfaces or winding An effective way to remove and replace rotor in horizontal generator is by using a rotor removal tool.
- 7. Internal Inspection

Look for and record the following:

- a. Water or dirt ingress (loose dust, watermarks or rust)
- b. Condition of stator and rotor cores-damage or overheating
- Condition of winding-discoloration, type of failure, if any

C. Removing the old winding and cleaning the core

 Recording the winding details – Document the appropriate fields to ensure that the winder can duplicate the winding.

Key points on recording the winding details

- a. Winding configuration (lap, concentric, single, two or three layers, etc.)
- b. Number of slots
- c. Number of poles
- d. Number, size and marking of leads
- e. Turns/coil
- f. Grouping
- g. Coil pitch







- h. Connections
- Coil extension/overhang connection end
- j. Coil extension non-connection end
- k. Number and size of wires in each coil
- Core loss testing Always use testers well within the manufacturer's recommended operating range. Core loss testers can be useful provided that the same tester at the same setting is always used for each test on a given core.

Key points on core loss testing

- a. Conduct all tests using the same core tester.
- b. Make sure the tests are conducted well within the manufacturer's recommended operating range for the tester being used.
- c. Carry out test (before burnout, after the core has been cleaned prior to rewinding)
- d. Remember that figures obtained are comparative, not actual losses.
- e. If the core loss increases by more than 20%:
 - (1) Make sure the settings of the core loss tester have not been changed and repeat the test.
 - (2) If the repeat test confirms the increased loss, repair the core or consider replacing it.
- Removing the old wiring The varnish and the insulation must be broken down before the windings can be removed from the stator core.
- 4. Cleaning the stator core in preparation for rewinding After the old winding has been removed from the core, slot insulation and other debris may remain in the slots. This must be removed carefully to avoid damaging the core.
- D. Rewinding the generator
 - 1. Copy (duplicate) rewinding

Key points on copy rewinding

- a. Check that old winding is manufacturer's original.
- b. Use same winding configuration.
- Keep coil extensions as short as practical.
- d. Same (preferably less) length of overhang.
- e. Use same coil pitch (or pitches).
- f. Use same turns/co l.
- g. Use same copper cross-sectional area.
- h. Use same Mean of Turn (MLT).
- Use same winding resistance.
- Completing the winding After fully inserting the winding, connect the coils and leads to
 match the original connections exactly. Use connection leads that are as large as practical
 and mark all of them correctly. Brace the coil extension as the manufacturer's original
 winding or better. After checking the coil extensions a final time, perform the required
 winding tests.
- 3. Winding tests
 - Winding resistance tests Measure the resistance of the first coil group wound. The resistance of the new coil group must be equal or lower than that of the original coil group. When the stator is fully wound, measure and record the resistance of each phase. Resistance of each should be equal within 5%.





- b. Phase balance (or surge comparison) tests Perform this test after the rewind but before impregnation. The test ensures that all three phases are wound and connected in the same way.
- c. Ground test/HI Pot Test The HI Pot Test voltage is intended as a proof test and should not be repeated. If additional HI Pot Test is required, it should be performed at 85% of the test voltages.
- Impregnation Impregnating the winding with varnish and subsequently air drying or baking this varnish until it is cured.

F. Reassembling the generator

- 1. Use correct grease.
- Ensure that the thrust washer is installed correctly.
- 3. Directional fans must be mounted correctly for the direction of rotation.
- 4. Avoid rough handling of the rotor.

5.6.4 Testing

- A. All tests, on completion of the rewinding works, in accordance with applicable standards, shall be carried out by the contractor to ensure that the equipment and materials comply with the specifications and operational requirements.
- B. The test equipment for proposed tests and procedures, test sheets, calculations and minimum/maximum test and performance values in conformance with applicable standards which will be used to determine conformance with the specification and acceptability of the equipment and installation at site.
- C. Upon completion of installation each component shall be tested to the complete satisfaction of end user. Contractor shall provide all test instrumentation, equipment and accessories necessary for demonstration of the tests and performance measurement.
- D. Upon completion of all testing the contractor shall submit a certified report attesting that each test has been performed in accordance with the approved procedures. The report for each test shall include the date of performance and the name of the person in charge or responsible for the test.

5.6.5 Commissioning

The commissioning shall be carried out by the Contractor in accordance with MARAFIQ approved procedure conforming to the specifications requirement. This shall include all necessary, materials; test equipment and testing to bring the unit back to a safe normal operation.

5.6.6 Performance Test

Performance tests of the unit after rewinding works and close monitoring of the generator shall be carried out by the contractor at 100% peak load and witnessed by Marafiq representative.







5.6.7 Training

The Contractor shall provide O&M training (for 4 persons) for MARAFIQ engineers / technicians ahead of Executing the Project.







Technical Specification and Setting Up

6.1 Generator Specification

Generator Specification

1. Quantity 7 Nos. Units (GTG-1, 2, 3,4,5,6 & 7)

.. Type & Form TFLQQ-KD Frame – 7E (Totally enclosed, self-ventilated, forced lubricated, direct

hydrogen cooled, solid cylindrical rotor machine.)

3. Capacity

Hydrogen pressure 2.1 kg/cm 2

Capacity 93300KV A at 15 C Amb , Temp

Power Factor 0.8

4. Rating Continuous

5. Voltage 13,800 V

6. Phase 3

Frequency
 Pole
 Pole
 2

9. Speed 3,600 rpm10. Rated exciting voltage DC 340 V

11. Connection Single star12. Short circuit ratio APP 0.5

13. Cooling conventionally cooled armature wdg

Directly cooled field winding

14. Insulation F class

Performance

1. Temperature rise limit

Hydrogen pressure 2.1 kg/cm
Armature winding 75 deg
Field winding 85 deg

6.2 General Description of Generator

The generator is completely enclosed including the ventilation system, fans and gas coolers to prevent entrance of foreign material.

The generator casing is substantially cylindrical in shape and of welded construction.

The end shields at either end of the casing are also of welded construction and support the rotor bearings and shaft seals. The all welded construction provides a hydrogen tight enclosure. The stationary armature is attached to and supported by the generator casing. The generator is designed for continuous operation and is constructed to withstand such conditions incidental to operation as suddenly applied loads or three-phase short circuit.

The generator auxiliaries provide control and/or supervision of the hydrogen pressure and purity, shaft seal oil, and temperature of windings, cooling gas, cooling water and lubricating oil.

6.3 Stator Frame and Spring Rod Supporting Method

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The stator frame is a welded steel plate structure and will endures vibration and unbalanced magnetic attraction which are caused during operation. At both ends of stator frame, strongly built end brackets are provided. Bearings for supporting the rotor are mounted to those end brackets.

The stator core is mounted to the stator frame through spring rods, which absorb the double-frequency vibration inherent to bipolar machines. Therefore, vibration of stator frame is minimized and quiet operation is assured.

Besides, the stator frame also serves as the passage of cooling air. The space between stator core back and stator frame are divided into several chambers by partition plates so that effective ventilation is assured.

6.4 Armature Core

The armature core is made up of segmental annealed insulated punching of Oriented silicon steel (to give minimum electrical loss) assembled in an interleaved manner on keys machined integral with the key bars (ribs) in packages separated by space blocks for ventilation. The punching are stamped from steel sheets and contains slots for the armature bars with dovetail slots for the wedges and other dovetails slots for assembly and locking of the segments on the key bars. The assembled punching is clamped into a stiff cylindrical core by pressure applied through end flanges of spheroidal cast iron by means of the stator key bars. Pressure is applied to the teeth by means of non-magnetic steel fingers located under the end flanges.

In order to reduce end heating from end leakage flux and its associated electrical losses occurring at the ends of the stator core, the end packages of punching are stepped back to increase the gap between the punching and the rotor. The punching insulation is a thermosetting varnish containing inorganic filler which maintains its insulating value even under the most abnormal effects of heat.

6.5 Armature Winding

The armature winding is formed by insulated bars assembled in the stator slots, jointed at the ends to form coils, and connected in the proper phase belts by bus rings. Each phase is split into groups of coils, one group lying under each pole.

The stator bars are composed of insulated copper conductors (strands) arranged in the form of rectangular bars by the transposition method, in which each strand is so assembled that is occupies, for an equal length along the bar, every radial position in the bar. This arrangement completely avoids eddy current looses under load conditions which would otherwise be caused by the self-inductive magnetic flux distribution in the coil slot. The assembled bars are insulated with several layers of mica tape and impregnated with the epoxy resin and these are continuously treated in the vacuum and heat treatment method.

In order to minimize the effect of corona, semiconducting paint is applied to the slot portion of the bar, with a higher resistance layer extending several inches beyond the core.

The end turns of the armature winding are securely laced with treated glass cord to the binding bands, which are insulated nonmagnetic steel rings supported from the stator core end flanges.

The armature bars are held in the coil slots by cloth reinforced synthetic resin wedges driven into the dovetail slots near the inner edges of the coil slots.







The terminal parts and bar in the slots are designed to fix in the long operation and even in the three circuit trouble.

6.6 <u>Temperature Detectors and Terminal Boards</u>

The resistance temperature detectors are embedded between armature coils of each phase where the highest temperature is to be observed. Also the resistance temperature detectors are so located as to measure the temperature of the gas entering and leaving the gas coolers.

The lead wires from these detectors are brought out through a gas tight gland in the generator frame and connected to terminal boards for connection to the temperature indicators and relays.

6.7 Generator Terminal Plates

Both the line and neutral terminals are drawn through the terminal plate outside of the upper part of the generator casing at the collector ring side.

The terminal plate of nonmagnetic steel is welded to the top of terminal box of the stator. The non-magnetic material is used for the terminal plate to reduce the eddy current caused by the armature current.

6.8 High Voltage Bushings

The line and neutral terminals are drawn out through the terminal boards by means of gas-tight high voltage bushings. These bushings consist of one-piece porcelain insulators containing a copper conductor and silver plate terminal study are provided at each end of the bushings for making the connections.

6.9 Ventilation of Stator

Ventilation of the armature core and winding is accomplished by forcing the cooling gas both inwardly and outwardly through the radial ducts in the core formed by the punching and space blocks. The circumferential plates in the frame in back of the core, together with the outside wrapper plate, form section which separate the frame into high and low pressure regions through which the cooling gases are forced into or discharged from the stator core.

The gas supplied to and discharged from these sections is conveyed through pipe or ducts which direct the cooling gas from the fans through the machine and back to the fans through the coolers.

The alternate inward and outward radial gas flow in the stator core resulted in substantially uniform cooling in the core and windings. Thus reducing temperature stresses in these parts and avoiding excessive local heating.

6.10 Generator Rotor (Mechanical and Ventilation)

The rotor is machined from a single alloy steel forging (Ni-MO-V steel). Prior to machining extensive tests are made to assure that the forgings meet the required specifications for physical and metallurgical properties. Longitudinal slots, machined radially in the body, contain the field coils. Additional slots machined in the teeth and under the coil slots, provide ventilation for the rotor body. The field coils are held in the slots against centrifugal force by wedges, both magnetic and non-magnetic types being used to secure proper flux distribution. These wedges are individually fitted and driven into dovetail openings machined in the rotor slots.

The rotor fans, provided for the ventilation of the generation are of the axial flow type. These fans are assembled near the ends of the rotor. The rotor is cooled from the surface by the gas forced into space or gap between the rotor and the armature core, both from the ends of the rotor and from the inlet sections in the stator core internally by the gas drawn through the ventilating passages in the rotor body. The gas drawn by rotation the section is a section of the rotor body.

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the sublets under the rotor coils and through the ventilation holes in the rotor coil is discharged into the gap between the rotor and the armature core.

The end turns of the field winding are cooled by the gas drawn into the ventilating ducts in the rotor body.

6.11 Field Winding and Retaining Rings

The filed winding consists of rectangular copper bars formed into coils. Several turns in one pair of slots around one pole form a coil. Several coils assembled around each pole to form the winding. The individual turns of the winding are insulated from each other by mica insulation. The coils are insulating the slot wall in the body portion by molded slot liners made from sheet mica, asbestos cloth, and glassbestos cloth. To provide maximum ventilation and cooling, the end portions of the field coils are left bare except for turn insulation of generate turns. Molded ring insulation is provided between the coils and retaining rings and asbestos base phenolic mold blocking is provided in the end windings to separate and support the coils and restrict their movement under stresses from temperature and rotation forces.

The end turns are held in place against centrifugal force by heavy retaining rings machined from high strength, heat-treated alloy steel forgings which are shrunk onto the rotor body ends. The centering rings are shrunk into the retaining ring.

6.12 Collector Ring

Exciting current is supplied to the field winding through the collector rings, which are connected with the winding through insulated copper bars assembled in the drilled out center bore of the rotor forging. At one end of the connection bars, terminal rods or studs, assembled in gas tight bushings in radial holes in the rotor shaft, connect the winding with the bars at the other end. Similar studs connect the bars with the collector rings.

The collector ring consists of a pair of grooved steel rings shrunk onto and insulated from the rotor shaft.

6.13 Brushes and Brush Holders

Two collector rings are fitted side by side at the side opposite to turbine of the rotor shaft. Brush is accommodated in the case of brush holder and a few brush holders are installed grouping together concentrically with the collector rings of copper bus rings. Each brush head has a semicircle groove conforming to the diameter of pressure coil spring. This groove face has been processed with the consideration that when the brush is set, the spring pressure works on the center line of brush and the brush is always pressed vertically with the collector rings surface.

The hole of bolt for mounting the brush holder on the bus ring is made into a slot to enable the brush holder to be moved a little in radial direction and further, it is so constructed as to enable adjusting the brush clearance (gap between brush holder and collector ring). This brush clearance is adjusted to about 3mm before first operation; however this clearance is liable to increase because of abrasion in the collector ring during operation. It is therefore necessary to check and adjust the clearance periodically so that it can be kept at about 3mm at all times.

The brush pressure coil spring used for the brush holder is a constant pressure spring, and once it is set, the subsequent pressure adjustment is not required, and the brush pressure is always maintained at 0.96kg approximately. However, if the brush wears down to about 33mm in length, the brush pressure reduces sharply. A proper number of renewal brushes should always be kept at hand to enable replacing at least the total number of brushes in use at all reasonable times. Also, check to see that each brush moves smoothly in the corresponding case and besides, tighten the pigtail terminal securely to prevent unnecessary poor contact from being caused between pigtail and bus ring.

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Further, it should be noted so that the pigtail leads are not caught by the brush holder or pressure coil spring; otherwise, smooth movement of the brush won't be ensured.

Generally, positive pole brush wears rapidly than negative pole one and on the contrary, negative pole collector ring tends to wear down more than positive pole one. In such a case where the negative pole collector ring surface becomes rough and as a result, abrasion in the brush increases, it is effective, for example, to change the polarity every 3 months of operation for prolonging the service lives of brush and collector ring.

6.14 End Shields and Bearings

The generator elliptical bearings, the shaft sealing devices, and oil supply and drain piping are supported and enclosed in the end shields.

The end shield is divided horizontally in two halves for easy dismantling. The fitting surfaces of these halves and of the end shield and the stator frame are finished precisely to assure the close contact between these surfaces, and are provided with grooves in which sealing compound is filled to insure the gas tightness. The hydrogen leakage through the shaft is prevented by the shaft seal devices. The generator bearings are assembled on the ball seats and collector ring end bearing is insulated to prevent the shaft current. The internal end cover is provided between the armature winding and the end shield.

The end cover prevents the short-path flowing of the pressurized hydrogen gas flowed back to the suction side of the rotor fans. The end cover is provided with nozzle rings to force the hydrogen gas pressurized through the guide vanes and rotor fans into the rotor and stator, so that effective ventilation is insured.

6.15 Shaft Seals

The air-tight seal at the place where the rotor shaft passes through the end brackets is maintained by a shaft seal of the oil film type. Seal rings made of special metal with an inner diameter slightly bigger than the diameter of the rotor are contained in the seal casing inside the alternator end brackets. These rings are divided into either two or four segments and are fastened in the radial and axial directions by garter springs. Although the rings are able to move in the radial direction together with the shaft, they are held in place by the pins at the top and bottom of the housing and will not turn around.

The sealing oil supplied between the seal casing and the rings runs through the inside of the seal rings in the radial direction, and between the rings and the shaft in the axial direction. Forming an oil film in these areas, it prevents the gas from leaking outside the alternator along the shaft. The oil heading inside the alternator is guided into the discharge groove inside the end brackets and from there flows into the seal oil drain pipes. On the other hand, the oil heading outside into the air is mixed with the oil draining out of the alternator bearings and enters the bearing oil drain pipes.

6.16 <u>Hydrogen Coolers</u>

The hydrogen cooler is guided with rails and supported on the generator casing. The hydrogen gas in sealed off by means of gaskets between the casing and tube sheets of the cooler. The inside of cooling water tubes of the cooler are able to be cleaned even when the hydrogen gas is remained in the casing, if only the header cover is taken off.

The water feeding pipes are all connected to the cooler outside the generator and the hydrogen coolers are removed every unit from the generator casing, if the water feeding pipes and gas tight gaskets are removed.

1. Outside Frame

The outside frame of the cooler consists of the side frame made of two welded steel plates, two end plates mounted top and bottom of the side frame above mentioned, several displaces provided between

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والمقربات والمقرد PROCUREMENT CONTRACTS DEI the end plates and the rails. These rails are machined with the guide slots mounted on the generator casing so that the cooler is easily taken off and brought in the generator casing by these rails.

These rails and guides make a close contact to prevent gas leakage; the hydrogen gas passes all through the cooler to assure the best cooling efficiency.

2. Cooling Tubes

The cooling tubes are made of special brass and tin-coated copper fins are soldered helically to the outer side of tubes to increase the cooling surface and to insure the good heat conductivity. As the cooling tubes are considerably long, they are fitted with collars of rubbers with a same interval with diaphragm plates which are closely fitted in the holes at the plate to maintain proper rigidity.

The outside diameter of the collar is a little larger than that of the fins, so that the fins of adjacent cooler tubes are kept out and they are prevented from vibration by means of the collars and diaphragm plates.

Header

The header and cover are fitted to the tube sheet by stud bolts and nuts and the stud bolts remain embedded in the tube sheet even when the cover is dismantled for inspection and repair.

At the top of the cooler, the cover is integrated with the header, while the cover is separated from the header at the bottom of the cooler.

Tube Sheets

Both ends of the cooling tubes are inserted in and expanded to the holes of the sheets made of special brass. The upper tube sheet is bolted to outside frame of the cooler, while the surrounding of the lower tube sheet has a small gap to the outside frame.

The lower tube sheet is able to move according to the extension and shrinking of the cooling tubes with heat cycles, so that the cooling tubes are not subject to the stress owing to the difference of the coefficient of expansion between the cooling tubes and the outside frame.

5. Gaskets

In order to make water-tightness gaskets are inserted between the cover and the header, and between the header and the tube sheet.

6. Air Vent

An air vent tube is provided with the cooler to prevent the stop of cooling water flowing to the air gathered in the upper header. The air vent tube passes through the cooling tube from the lower header up to the upper header and a hole plugged during the normal operation is provided with the upper header cover at the position just over the outlet of the air vent tube in order to clean the air vent tube easily through the hole. That hole is also used as an emergency air vent hole.

7. H2 Cooler

Drain the water in the H2 cooler and enclose N2 gas to avoid the cooler tube from causing rust, when the water in the H2 cooler is to be stopped in the condition the generator in at a standstill for more than one week for an inspection or rectification.

However, in case the water in the H2 cooler is to be kept flowing though the generator is stopped there is no necessity to enclose H2 gas.







SECTION - IV H

REPLACEMENT OF AC/DC
POWER, CONTROL &
INSTRUMENTATION SIGNAL
CABLES FOR GTG UNITS 1-8







I. TECHNICAL REQUIREMENTS

1. General scope of services

The work to be performed under this contract consists of furnishing; labor, supervision, tools, equipment, technical and professional services, materials supplies and all articles necessary to perform work involved in replacement of existing, low voltage underground aux power and control cables between the various auxiliary compartments and machines for all GTG-1 to 8 units at Power & Water Complex facilities of MARAFIQ Yanbu

The program requirements of this project shall include the "replacement of the existing defective underground cables, rehabilitation of damaged duct banks or the option of installation of above ground with new cables & conduits, as appropriate, as well as renovating the existing duct banks. These cables are low voltage auxiliary Power and Control connections between the Gas Turbines Units and their controls and aux compartments for GTG units No's 1~8.

The scope of work for replacement of the underground cables & conduits, rehabilitation of the duct banks includes and or above ground installations of cables and conduits includes but not limited to the followings;

- 1) The Hot Zones near Gas Turbine Machines (Appendix-2.1 to 2.8)
- 2) MCC to Radiator Skid Power & Control (Appendix 2.9)
- Gas Control Valve to Mark V from JB-30
- 4) JB 19 Cables from field, per Cable Schedules
- 5) Radiator level Switch Cable -- 25 Meters for each unit
- 6) JB1 to Gauge Panel (Pressure Switch) 25 Meters for each unit
- 7) JB1 to DC Compartment Cables ——— 20 Meters for each unit
- 8) JB 68 & JB 69 to JB68A & JB 69A Cables per Cable Schedules
- 9) Fire cables and wires (ref Appendix-2. 9 for details)

The hot zones have been typically identified and marked on a set of drawings and documents for GTG-8, executed in the past, given inside Appendix-2.1 to 2.3, being provided for reference only. This information shall be applicable to each of the Gas Turbine Generator units from GTG-1 to 8.

The rest of power and control AC / DC interconnecting cables and conduits, duct banks /trenches / manholes, between the various controls, auxiliaries, inter compartments and the machines shall also be field verified by the contractor.

The work related to the cables and conduits replacement and or rehabilitation of the duct banks shall be carried out, only during the major inspections/turnarounds of each of the Gas Turbine Generators units, No. 1 to 8, and shall be evenly coordinated with their schedules for their respective activities.

The contractor's scope of work shall include preparing and submitting the complete detail design package subject to be approved by Marafiq before starting any field work for the replacement of the defected cables.

The project work shall include cable identification, field verification for both ends existing terminations by testing, of the inter compartments and main machines underground LV aux power and control cables route from the both ends and to prepare new termination and routing layout drawings, as necessary, based on field information and submit to Marafiq for review and approval, before starting of field works for replacing the defected cables along with conduits and renovation of duct banks.

The site works shall include disconnecting and removal of identified existing aux. power and control defective cables and replacing with the new cables and conduits.





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The project works shall include research and apply the design information on the existing drawings & design documents to be searched, by the contractor, from the Owner's files, available in the Documentation Center / technical library at Yanbu.

The field cables and conduits subject to replacement are mostly routed through the underground trenches/ ducts/ Manholes either direct or via junction boxes, pull boxes, to the controls and the related equipment on the other end. The project work shall be carried out in to various phases of execution and only during the major inspections or turnaround periods of each of the machines.

2. Scope of Supply (Services & Materials)

The scope of supply of this contract includes the provision of services and materials required for accomplishment of the project objective. It includes but not limited to supply of appropriate type and size of cables, installation and termination materials, as separately described under Equipment & Materials head, and services for installations, testing and commissioning as replacement of the existing cables arrangements performing the same function, as in the existing cabling, terminations, and mounting hardware for new installation. The extent of supply includes all new materials and specialist skilled professional services well aware of GTGs installations works.

The Contractor scope of work covers following for thermocouple extension cables, instrumentation signal cables and Power Limited Fire Alarm Signal Cables.

The Contractor shall design, supply, install, test and commission silicone insulated with outer sheath of glass fiber or silicone withstanding high temperature thermocouple extension cables for hot zone section of turbine wheel space and exhaust duct thermocouples.

All field instruments' signal cables, control cables connected with junction boxes JB-1, JB-19, JB-20, JB-30, JB-68, JB-69, JB-68A and JB-69A for GTG monitoring, protection and control from local control room and a central control room, shall be replaced with new high temperature silicone insulation cables in existing duct bank, trenches and conduits. New high temperature silicone insulation cables shall be suitable for high temperature environment and of heavy duty type with design life not less than 30 years.

(1) The contractor shall replace existing high temperature FEP/Silicone insulation thermocouple extension cables with new high temperature insulation cables. The new cables shall be laid down in existing conduit, duct bank. The Contractor shall replace cables from field thermocouples to field junction boxes JB#20, JB#68 and JB#69 for GTG-1 to GTG-8.

Type of thermocouple extension cables is "K" type as per ISA/ANSI MC96.1

JB#20-Turbine Wheel space Thermocouples, Lube System Bearing

Thermocouples (Drawing# 10S-261-061, 10S-261-062, 10S-261-063, 10S-261-064, 10S-261-065 and 10S-261-066)

JB#68- Turbine Exhaust Duct Thermocouples

JB#69-Turbine Exhaust Duct Thermocouples

Refer the drawing #10S-261-046 for location of Junction Boxes.

Single pair shielded high temperature thermocouple extension cables shall be laid down from field thermocouples to existing JB. Existing cable routing shall be followed.

(2) The Contractor shall replace multi pair high temperature FEP/silicone insulated with FEP/silicone outer sheath shielded thermocouple extension cables from junction boxes JB#20, JB#68 and JB#69 to Mark-V. New multi pair thermocouple extension cables shall be laid down in existing conduit, trench and duct. However where there is practical problem for laying new cables, the contractor shall lay down per page 100 and conduit adjacent





to existing conduits. Length of new conduit shall be approximately 30 meter for each GTG. Size of the conduit shall be 2" either RGS or Aluminum.

- (3) The Contractor shall replace existing single pair high temperature silicone insulated instrumentation signal cables for pressure switches connected to JB-1 as shown in drawing# 10S-261-047, 10S-261-048, 10S-261-049, 10S-261-050 and 10S-261-051).
- (4) The Contractor shall lay down new separate dedicated double insulation, high temperature UL listed fire alarm cables in new conduit from smoke detector to its respective Fire Alarm Control Panel as shown in drawing#AR10751-IN-A3-001-A. Existing fire alarm cables are laid down along with other instrumentation signal cables in same conduit. As per NFPA#72 Fire Alarm Signaling Code, NEC article 760, Fire Alarm Cables shall be laid down in separate, dedicated conduit. Existing Fire Alarm cables shall be replaced with new identical one in separate dedicated conduit as shown in drawing.
- (5) The Contractor shall replace existing radiator level switch instrumentation signal cables with new identical one of single pair multistrand shielded instrumentation signal cables. The contractor shall follow the existing routing of the level switch cables for GTG-1 to GTG-8.
- (6) The Contractor shall replace existing single pair and multi-pair high temperature cables wired to JB-19 and JB-30. All field instruments cables which are wired from fuel gas control valve to JB-30 through intermediate junction box shall also are replaced with identical one. Existing multi-pair cables of JB-30 shall be replaced with silicone insulated high temperature instrumentation signal cables as shown in drawing# 10S-261-067. New multi pair field instrumentation signal cables shall be routed in existing conduit, duct bank and trenches and shall be terminated in existing Mark-V cabinet. Refer existing drawing# 16075-2E-0-0016 for cable routing.

Cable routing: Existing cables are laid down through various duct banks, trenches and rigid conduits. The Contractor shall strictly follow the existing routing for replacing high temperature cables for existing junction boxes. Existing routing of cables inside accessory compartment and turbine compartment shall be followed for cable replacement.

1. EQUIPMENT AND MATERIALS SPECS

The contractor shall provide materials and equipment that are new, of the type and quality specified. Materials and equipment shall be manufacturers' standard products in compliance with referenced standards and adequately described by published product information. Products to be used in hazardous classified areas shall be rated for the specific classification of each area.

All kinds of the equipment and materials to be used on this project are subject to the Marafiq approval before delivery at site and inspected at site prior to the installation. The specs of major materials required for this project includes but not limited to the followings;

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3.1 LV POWER AND CONTROL CABLE

A-Low Voltage Cable (600 V nominal)

- General: Cable shall be suitable for installation in conduits or ducts above and below ground and for exposed installation in cable trays. Cables shall be suitable for operation in wet or dry locations with alternatively wet and dry conditions. If exposed installations in cable trays are used, cable shall be suitable for operation in a sandy and salty atmosphere without affecting its physical and electrical characteristics.
- Conductors: Conductors shall be uncoated, annealed, solid or stranded copper in accordance with IEC 228. Sizes 6 mm² and smaller shall be solid or stranded and sizes 10 mm² and larger shall be stranded. Minimum size shall be 4 mm² for power and lighting and 1.5 mm² for control.
- 3. Insulation: Insulation shall be a heat, oil, moisture and ozone resisting compound suitable for maximum conductor temperature under normal operating conditions. Cable insulation systems and materials shall be as follows:
 - (a) 85°C PVC in accordance with 5ASO 55, IEC 227 and IEC 502 or other applicable standards.
 - (b) 90°C cross-linked polyethylene (XLPE) in accordance with ICEA S-66-524 or equivalent standards.
 - (c) 90°C ethylene propylene rubber (EPR) in accordance with ICEA S-66-516 OR equivalent standards.
- Jacket: The jacket compound shall be a thermosetting flame retardant compound, heat, oil, moisture
 and ozone resistant materials such as neoprene or hypalon.
- 5. Tests: Cable shall be tested in accordance with the latest requirements of ICEA S-66-524 and S-68-516 or IEC.

Cable shall be tested to determine the capability of preventing the propagation of fire and to determine its self-extinguishing characteristics.

Note: All cables used in cable trays and underground duct banks shall have flame retardant characteristics.

- 6. Application: Cable applications shall comply with the following:
 - (a) Building interior lighting and power wiring shall be in conduits or closed raceway systems and shall be single core, non-sheathed insulated cables. The cable voltage rating shall be 600 V.
 - (b) Building interior control and instrumentation wiring shall be in conduits or closed raceway systems. Refer to RC Spec Section 16912 for control, instrument and telecommunication cables requirements.
 - (c) Outdoor above grade wiring in conduits or closed raceway systems shall have the same requirements as for building interior wiring.
 - (d) Below grade circuits in ducts and power circuits indoors shall use single core, XLPE or EPR insulated cables, non-sheathed and rated 600/1000 V. Cables shall be rated for wet locations and maintain 90°C rating.



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- (e) Cables used in cable trays shall be XLPE or EPR, single or multi core, 90°C, 600 V or 600/1000 V and rated for use in cable trays.
- 7. All cables shall be permanently marked in accordance with NEC Article 310-11.
- 8. Factory tests shall be performed in accordance with requirements of the applicable standards.
- Color code cables for phase identification per RCEC Section 210-5 and as specified herein. Use colored bands of tape on exposed ends of cable insulation to code cables, if correct color scheme is not available
- 10. Feeder and branch circuit neutral conductors shall be the same size as phase conductors.
- 11. Deliver wire and cable to the site of the project in original packaging or on factory reels, fully identified with tags or labels, indicating the manufacturer's name and date of manufacture.
- B- Bare Conductor: ASTM B8 class B stranded annealed copper conductor unless otherwise shown.

C-High temperature cables

Silicon insulated cables shall be used for applications such as turbine exhaust duct, turbine wheel space, lube system bearing temperatures and field instrumentation signal cables in temperatures between 0°C up to 300°C. Stranded conductors shall be to BS 6360/VDE 0295 Class 5. A glass fiber braid shall be applied over the silicon insulation, with a silicon outer sheath. Where mechanical protection is required, a glass fiber tape shall be applied over the silicon sheath.

Cables insulation and sheath (outer jacket) shall be suitable for continuous temperature of 200º C in GTG compartment. High temperature cables shall be UL listed.

Double insulated high temperature UL listed fire alarm single pair twisted pair cables shall be used for existing smoke detector interfacing to existing Fire Alarm Control Panel(FACP) as shown in drawing# AR10751-IN-A3-001.

2. Installations requirements

A. Decommissioning the existing

- I. Contractor to prepare and submit procedure / method statement in order to carry out the identification and decommissioning of existing aux power and control cables network of the GTG unit and associated compartments.
- II. Contractor to Identify the existing power and control cables route, destinations and terminations with lettering or equivalent means before decommissioning of any of the power and or control cables in order to return same installation with new cables and materials.
- III. Provide conductor identification within each enclosures, pull boxes, manholes and hand holes

B. Installation of new cables

I. Install new cables and conductors only when the raceway and or the duct system have been cleared.

Thoroughly clean the inside of all conduits of any dirt, moisture or other foreign materials before an units.



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wire and cable. Pull wires and cables in conduits after an application of suitable lubricant that shall have no injurious effect on the insulation of the conductor. No oil or grease shall be used.

- II. Each power conduit shall contain a grounding conductor.
- III. Splicing and Joints: Make no splices or joints in low voltage feeders or branch circuits except at accessible splice or junction boxes, accessible raceway fittings or outlet boxes.
- IV. Secure joints in circuit wiring mechanically and electrically. Joints in wet locations shall provide a moisture seal equal to the cable insulation.
- V. After cables are pulled through a manhole or handhole, the ducts shall be sealed around the cable with non-hardening sealing material that will not harm the cable insulation.
- VI. Identify all power conductors by color coding as follows:

Conductor 120/208 V or 127/220V	220/380 V
Phase A – Black	Brown
Phase B – Red	Orange
Phase C – Blue	Yellow
Neutral – White	White
Ground – Green	Green

If available cable does not contain colors corresponding to the table, color bands of tape shall be applied to all exposed ends of conductor insulation.

VII. Identify control wiring by color-coded, plastic-coated, self-sticking printed markers, permanently attached stamped metal foil markers, heat shrink tubes with permatized lettering or equivalent means. The identification of each control wire shall consist of a unique number corresponding to schematic and wiring diagrams. Provide conductor identification within each enclosure where a tap, splice, or termination is made. Identify control circuit terminal on equipment also. Match terminal and conductor identification with that shown on approved shop drawings. Hand lettering or marking wire tags and terminal is not acceptable.

3. Inspection and testing

A. visual inspection

Visual inspection of the completed works shall be carried out by the end user after completion of the entire installation works for the proposed aux power and control cables on the Gas Turbine Generating unit (s) designed for the project works.

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B. field testing

The contractor shall submit test plan and procedures to the Owner's approval prior to testing. Test procedures shall include test descriptions, test equipment descriptions, test sheets, calculations and minimum/maximum test and performance values to be used in determining the acceptability of the installation including equipment. The contractor shall perform tests and checks on installed cables and related installations prior to the commissioning. Perform tests and checks in accordance with Marafiq approved test plan and procedures that conform to the applicable standards. Tests shall be subject to witness by Marafiq representative. All test equipment shall be provided by the Contractor. Test the insulation resistance of each conductor with 500 V DC Megger. Measure resistance to ground and between conductors. Record the results by feeder and branch circuit number. Conductors of the same circuits shall have comparable values. Upon completion of testing, submit four copies of certified reports attesting that each test was performed in accordance with the approved test procedures and to the



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complete satisfaction of the Owner. The report for each test shall be recorded on the forms approved by the Owner and includes the date of performance and the name of the person in charge of the test.

4. Commissioning

The commissioning and re-energizing of the system shall be carried out by the contractor following the accomplishment of the installation works and successful conclusion of inspections and testing. The commissioning of the entire system shall include demonstrating of the concerned turbine unit's operation and to the full satisfaction of the end user's representative at site.

5. Initial acceptance

Upon completion of work and clearing the site from all debris, the contractor may give notice for inspection to the MARAFIQ for initial acceptance of the work. If such inspection confirms that the work is completed in accordance the contract and shall have satisfactorily passed functional test, MARAFIQ may issue a certificate of Initial Acceptance. And the warranty period will start from the date of Initial Acceptance of the work, Moreover, Initial Acceptance of the work shall be conditioned upon but not limited to the followings:

- Receipt of the all MARAFIQ approved technical submittals as required by the relevant part (s) of the contract.
- b) Receipt by the MARAFIQ of As - Built drawings, Test and Inspection Certificates, Original Drawings etc. as required by this contract

6. Engineering and design responsibilities

- The required professional services shall include; complete design development, including the review of information provided in the contract documents, preparation of the final as-built drawings and all necessary documents as required, and related other professional services in connection with, as specified herein, except as may be specifically excluded in the contract document.
- b) The engineering and design responsibilities, under this contract, shall include to research, obtain and apply design information on relevant existing system drawings &design documents by utilizing technical documents from the Owner's files, available in documentation center in the P&W complex.

7. Applicable codes and standards

Contractor shall comply with the applicable provisions of the latest edition of the following standards except as otherwise herein specified.

1. Saudi Arabian Standards Organization (SASO):

> (a) 55 **PVC Insulated Cables with Circular Copper Conductors**

(b) 56 Methods of Test for PVC Insulated Cables and Cords with Circular Copper Conductors

International Electrotechnical Commission (IEC): 2.

> 227 (a) Polyvinyl Chloride Insulated Cable of Rated Voltages up to and including

450/750 V





- (b) 228 Conductors of Insulated Cables
- (c) 811 Series Common Test Methods for Insulating and Sheathing materials of Electric Cables and Cords
- 3. Insulated Cable Engineers Association (ICEA):
 - (a) S-66-524 Cross-linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electric Energy (NEMA Pub. No. WC 7)
 - (b) S-68-516 Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

(NEMA Pub. No. WC 8)

- 4. American National Standards Institute (ANSI):
 - (a) C 80.1 Specifications for Rigid Steel Conduit, Zinc-Coated.
 - (b) C 80.3 Specification for Electrical Metallic Tubing, Zinc Coated.

8. Technical submittals

Contractor shall submit to MARAFIQ for review and approval of the followings, before commencing the work:

- A. All materials, cables and wires and other misc. items required on this project shall be submitted for approval before procurement.
- B. The contractor shall submit manufactures' catalog technical and descriptive data for all materials and products including test certification that the materials complying with the required standards/specifications.
- C. The contractor shall submit a detailed method statement for installation and termination of proposed equipment in the panels.
- D. Test Reports: Submit manufacturers' factory test reports or certification of factory tests for wires and cables.

 Test reports shall show compliance with applicable standards. Submit field test plans and field test reports.
- Calculations: The submittal of calculations shall include the followings as minimum;
 - a) Cable sizing (load current and voltage drop)
 - b) Cable pulling tension
- F. Testing & Commissioning documents: Submit all testing and commissioning procedures and subsequent test reports subject to Marafiq approval.

9. Final acceptance certificate

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The contractor may notify to the MARAFIQ to issue a Final Acceptance Certificate at any time after the end of the warranty period, provided contractor has satisfactorily performed its obligation under the contract. The MARAFIQ will, within thirty (30) days of the delivery of such notice, verify the completion of the work and either issue to contractor the Final Acceptance Certificate indicating the date on which Final Acceptance Certificate is issued were completed or specify the deficiencies, which are required to be completed before issuance of the Final Acceptance Certificate

10. Commencement and completion of work

Contractor shall commence performance of work upon the date specified in the formal notice to proceed issued to Contractor there under and shall furnish sufficient personnel, materials, tools and equipment, so as to execute the work within the advised period of time. The contractor shall observe and exercise therein the professional standards of skill; care and diligence adhere to by first-class contractors performing work of a similar nature. Unless otherwise expressly provided herein, all materials and equipment shall be new and shall conform to the specifications, drawings, samples and other descriptions set forth in this contract or provided by contractor and approved by MARAFIQ; and where not specified, such materials and equipment shall be the most suitable grade of their respective kinds for their intended use.









SECTION - IV I

REPLACEMENT OF EXHAUST PLENUM FOR GTG UNITS 1-8







I. TECHNICAL REQUIREMENTS

1. Engineering & design responsibilities

The required professional services shall include, review design for internal pin spacing, pin size, liner plate thickness, and clamping system positioning to ensure system integrity

2. Scope of Work

Following are the components of exhaust gas system removal & installation.

The contractor will remove & install the exhaust system but not limited to the following.

- Exhaust Frame.
- Exhaust Diffuser.
- Exhaust Silencer Duct & Baffles.
 - One low frequency silencer that has a duct (WxHxL) 21'4" x 17'8" x 124" with 6 low frequency silencer panel.
 - One High frequency silencer that has a duct (WxHxL) 21'4" x 17'8" x 72" with 13 low frequency silencer panel.
- Expansion Joint.
- Remove & install all instrumentation.
- Ensure QA/QC work with Test Certificate.
- Follow OEM recommendation for bolt tightening torque values.
- For lifting, tested slings should be used & correct positions.
- The contractor will submit all the inspection report duly signed by Marafig representative.
- MARAFIQ reserves the right to witness all of testing and inspection activities per approved plan. Test records shall be submitted for the entire system.
- The contractor will arrange qualified rigging expert for removal & installation of exhaust gas components.

3. Technical Specification

Silencer casing is made of Carbon steel S235JR or Equivalent with stiffening profiles according to structural requirements.

The internal insulation and silencer baffles infill is wrapped with one layer fiberglass cloth, one layer fiberglass mat and one layer of Stainless steel screen.

The solid and perforated lining is manufactured from 1.4512, type 409 stainless steel sheets, liner sheet thickness is 0.12", and insulation thickness is 3".

Silencer baffles manufactured from 1.4512, type 409.

Coating

Ductwork, external surfaces and stack support

Sandblasted SA 2.5

Primer 75micro.m Zinc primer Top coat to be applied at site

Duct work internal surfaces

Not Sandblasted, not painted (Primer will be applied up to first row of insulation studs at the erection joint areas)

Reference Drawing

Serial Number	Drawing Number	Description
1	10P087	Exhaust Plenum Arrangement

4. Acceptance Criteria

After installation measure the skin temperature of Duct & acoustic performance.







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SECTION - IV J

REPLACEMENT OF SHUT OFF & BYPASS DAMPER GEARED MOTOR FOR GTG UNITS 1-8









I. TECHNICAL REQUIREMENTS

Scope of Work for Shut off Geared motor and By pass damper Motor with gear box

Following are the components of exhaust gas system removal & installation.

The contractor will remove & install the new Shut off Geared motor and By pass damper motor with gear box but not limited to the following,

2. Technical Specification

The following the Technical Details for the Existing System, the new installation should suit for the Existing System with minor modification by the Bidder.

Shut Off Damper Geared Motor with Magnetic Brake Specification

Type : TOAG -KK

KW : 30 Speed Reduction : 1/10

Poles : 4 Mfg. : Y475400 RPM : 1800

Make : Hitachi Seisakusho Company

Magnetic Brake Specification

Type : MS J32
Form : H.B.D
Volt : 440V -1.8A
Mfg. : E45281A0

Rectifier unit Specification

Part/Model : BS104B

Volts : 440-460V

Cycles : 50/60HZ

Lot : 104B, 1-02

Make : Hitachi NC 20282

By Pass Damper Motor

Mfg. : NIDEC Power Motor Corp, Japan

KW 1.5 440 Volt **Poles** 4 60 HZ Frequency 3.3 Amp **Breaking Ratio** 25% **RPM** 1720 SI.No 6Z2629101

Gear Box

Frame : 7001E

Gear Box : Internal

TYPE : DMR 8005

Serial : R0650

Make : Matusima









SECTION - IV K

REPLACEMENT OF PROTECTION RELAY BY DIGITAL TYPE OF GTG UNITS 1, 2, 3, 4, 7&8







I. TECHNICAL REQUIREMENTS

1. Project Purpose

The purpose of this Project is to replace the existing electromagnetic protective relaying system with new advanced microprocessor based protection relays to achieve more secure and dependable protective relaying for following systems:

Gas Turbine Generators GTGs 1, 2, 3, 4, 7&8 13.8/115 kV Step up Transformers except for GT-56 13.8/4.16 kV Unit Auxiliary Transformers for GTG units GTGs 1, 2, 3, 4, 7&8.

2. Existing Condition

The 77 MVA Gas Turbine Generators (GTGs) are connected to the main electrical network through a common three-winding Step-up Transformer. Each GTG has its own separate Unit Auxiliary Transformer (UAT) connected by isolated phase bus duct. Each generator is connected to the Step-up Transformer through Generator Circuit Breaker. Protection panels for the two Gas Turbine Generators, Step-up Transformer and two Unit Auxiliary Transformers are housed in two numbers each panels installed in Local Control Compartment of each GTG (total four panels). The generators are in operation.

The other facilities in MYASPP are energized and are in operation and should be kept operating throughout the work under this Contract.

3. Project Location

The project location is inside MARAFIQ power and water facility located in Madinat Yanbu Al-Sinaiyah. The work of the project shall be within MARAFIQ Yanbu Power & Desalination complex for GTG GTGs 1, 2, 3, 4, 7&8

4. Reference Documents

Attached are the following documents for reference by Contractor.

- 1. Single line diagram
- 2. Panel layout
- 3. Existing protection details

INSPECTION, TEST PLANS AND REPORTS

The Contractor shall develop a detailed Inspection & Test Plan based on the project quality, test and inspection requirements indicating all hold points and MARAFIQ witnessing stages. The Inspection & Test Plan shall be submitted for MARAFIQ review and approval.

Test procedures shall include description of test equipment, test equipment connection diagrams/sketches, test sheets, calculations, and minimum/ maximum test and performance values to be used in determining the acceptability of the installed equipment.

Manufacturer's factory test reports for all supplied equipment shall be submitted to MARAFIQ. Test reports shall show compliance with applicable international (IEC/ANSI/IEEE) standards. All field test reports shall be submitted for MARAFIQ review and record.

The Contractor shall give at least three days (72 hours) advance notice to MARAFIQ to conduct inspections witness specified test in the Contract. MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of such inspection of the MARAFIQ shall confirm exact day and time of the MARAFIQ shall confirm exact day and time of the MARAFIQ shall confirm exact day and time of the MARAFIQ shall confirm exact day and time of the MARAFIQ shall confirm exact day and the MARAFIQ shall confirm e





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All shops and field testing certifications, reporting, and assuring of work quality verification, documentation of the work shall be performed by the Contractor at his expenses and in accordance with the technical specifications and description of the work.

The Contractor shall be responsible for all inspection and testing as required by the applicable codes for sound construction and engineering practices & norms specified herein. In addition, all work performed by the Contractor shall undergo inspections & testing witnessed and approved by MARAFIQ or its authorized representative.

MARAFIQ shall have the right to reject any part of the work found to be unsatisfactory or not in conformity with the approved standard, and the rejected work shall be satisfactorily corrected, revised or replaced at Contractor's expense.

Upon completion of testing, submit three (3) copies of certified reports attesting that each test performed was in accordance with the approved test procedures and to the satisfaction of MARAFIQ. The report for each test shall be recorded on the forms approved by Marafiq.

All test reports of factory and field tests shall become part of the Operation and Maintenance manuals.

TESTING AND COMMISSIONING

The Contractor shall be responsible for Commissioning of the new system and shall take satisfactory trials and handover to MARAFIQ.

Commissioning and energizing of the entire facilities include demonstrating, installation, system operation to the satisfaction of the MARAFIQ representative at site.

At least one month prior to commissioning and start-up, the Contractor shall submit an outline of the commissioning plan and procedures subject to MARAFIQ approval. This outline shall include a brief description of the test equipment, connection diagrams, proposed tests and procedures, test sheets, calculations, reference drawings and minimum/maximum test and performance values with applicable standards which will be used to determine conformance with the specification and acceptability of the equipment and installation.

The Contractor shall prepare all required design drawings in CAD for the protection panels incorporating the new protection relays. The final As-Built drawings shall be one (1) set of original drawings, one (1) set of electronic copy with drawing list in Bentley Micro Station (release J or onwards) of (DGN) format on compact disc/s to MARAFIQ.

INITIAL ACCEPTANCE

Contractor shall notify MARAFIQ upon the completion of the work including satisfactory completion of the tests required as per the technical specifications. Such notice shall be in writing and shall be deemed to be a request by Contractor for MARAFIQ to issue an Initial Acceptance Certificate. MARAFIQ will, following delivery of such notice, conduct inspection of the completed work and either issue to Contractor the Initial Acceptance Certificate indicating the date on which the work for which an Initial Acceptance Certificate is issued were completed, or notify the Contractor of the unfinished portion of the work or specify the deficiencies which are discovered and are required to be completed by Contractor within a mutually agreed time limit before the issuance of such certificate. Upon completion of specified unfinished portion of the work or correction of the specified deficiencies, Contractor shall so notify MARAFIQ in writing and MARAFIQ either to issue an Initial Acceptance Certificate or give Contractor notice of failure to complete the specified unfinished portion of the work or correct the specified deficiencies.

Initial Acceptance of the Work shall be conditioned upon but not limited to the following:

Receipt of the all technical information as required by the Contract



MARAFIQ AC PROCUREMENT & PROCUREMENT & CONTRACTS DEPT.



- 2. Receipt by owner of record documentation such as RSPL, O & M manuals, Inspection & Test Certificates and As-Built Drawings in hard and soft copies (in Bentley Micro Station).
- 3. Completion of all provisions of MARAFIQ Project Instructions.

WARRANTY

The Contractor shall provide warranty of the equipments or part of the project work against defects in materials, equipment and workmanship for the period specified herein under title "Warranty Period" from and after the date of completion and acceptance of the project. All costs incidental to such rework and testing thereof, including the removal, replacement and reinstallation of equipment and material necessary to gain access, and all other costs incurred as a result of the breach of warranty shall be borne by the Contractor.

"Warranty Period" means the period of twelve (12) months cumulative and successful operations after the date of completion of the work of the Initial Acceptance Certificate or eighteen (18) months from the date of completion of the Work of the Initial Acceptance Certificate, whichever ends sooner. Cumulative means the total number of days of successful operation.

FINAL ACCEPTANCE CERTIFICATE

The Contractor may notify to MARAFIQ to issue a Final Acceptance Certificate at any time after the end of the warranty period, provided the Contractor has satisfactorily performed its obligation under the contract. MARAFIQ will, within thirty (30) days of the delivery of such notice, verify the completion of the work and either issue to Contractor the Final Acceptance Certificate indicating the date on which Final Acceptance Certificate is issued were completed or specify the deficiencies, which are required to be completed before issuance of the Final Acceptance Certificate.









II. Scope of Work

1. Description of work

A. Work required by this Section includes the engineering, design, studies & research, equipment, labor, installation, testing, commissioning, training and supervision necessary to provide complete and functional microprocessor based protective relaying systems. The microprocessor based protective relaying system shall be installed in place of existing electro-mechanical protective relaying system. The new equipments installed shall be coordinated and integrated with other existing systems. The protective Relaying panels are located inside the Local Control Cabinets of each GTG. Removing these panels is difficult without dismantling part of the Local Control Cabinet. Hence, the intent of this project is to replace the relays and other related items in the panel without removing the panel itself.

Contractor shall be totally responsible for all activities necessary to produce engineering and design documents and installation and construction works that are acceptable to MARAFIQ. The protective relaying system shall be designed with the new microprocessor based multi-function relays. The design philosophy shall follow the existing system for functionality.

The Contractor shall possess adequate in house capability to perform the specified engineering and design works.

The Contractor shall be responsible for providing the complete, operable, and acceptable installation including all required materials, services and equipment.

The Contractor shall be responsible for developing the complete and final program requirements for this Project.

B. Locations of the work are:

GTGs 1, 2, 3, 4, 7&8

13.8/115 kV Step Up Transformer

13.8/4.16 kV Unit Auxiliary Transformer GT-UAT

13.8/4.16 kV Unit Auxiliary Transformer GT-UAT

115 kV Switchgear Building.

The two Local Control Cabins for the GTGs where the protection panels are located.

Duct banks and cable racks.

- C. Major elements of work involved include but not limited to:
 - Replacement of the existing protective relay system equipments in the existing protection panels with new microprocessor based multifunction relays and other related equipment including wiring and interconnections for GTG- GTGs 1,2,3,4,7&8, 13.8/115 kV step up transformer and two 13.8/4.16 kV Unit Aux. Transformers for GTGs 1,2,3,4,7&8.
 - 2. Interface of new protection panels with SCADA and annunciation system.
 - 3. Testing and commissioning of new protective relaying systems.
 - 4. Disconnect and remove the existing protection relays, timers and other auxiliary relays and wiring which are not usable with new arrangement.
 - 5. Cabling, wiring and integration of the new protection equipment with all other existing control and protection system and equipment.
 - Move and deliver safely all the dismantled and replaced materials from the site to MARAFIQ Yanbu warehouse.
 - 7. Grounding of the new installations as required.

Major elements of equipment supply and installation include but not limited to







1. The list of protection relays in the existing Protection Panels are listed below. The protection panels consist of these relays, timers, auxiliary relays indications and termination devices etc. that are to be replaced. For more details refer to the reference drawings attached. The list of protection functions/relays are provided for an overview of the existing protection system. Contractor shall offer new microprocessor based multi-function protection relays and other devices to achieve all the protective functions in the existing system as a minimum. The design philosophy should follow the existing scheme. Refer to the protection One Line Diagram of GT Generator and Unit Substation drawing attached.

Protection Relays Installed in Protection Panel for GTG 1, 3 &7

Exist. Panel	Existing Device no	Protection Function	Existing make	Existing Type
NP-01	87/G1	Generator Differential relay	Hitachi	IY-B1
NP-01	87-1/G1	Generator Differential relay	Hitachi	IY-B1
NP-01	59/81-1/G1	Over-excitation relay (V/f relay)	Hitachi	SVF-E1
NP-01	59/81-2/G1	Over-excitation relay (V/f relay)	Hitachi	SVF-E1
NP-01	40-1/G1	Loss of Excitation relay	Hitachi	UE-E1
NP-01	40-2/G1	Loss of Excitation relay	Hitachi	UE-E1
NP-01	51V-G1	Generator Protection Backup relay- (Over-current relay with voltage restraint)	Hitachi	IOV-C-B1
NP-01	32-G1	Reverse Power relay	Hitachi	IH-C-B1
NP-01	46/G1	Negative Phase Sequence relay	Hitachi	IPO-SC-2G2
NP-01	27/B1	Generator Bus aux relay	Hitachi	MM4XP
NP-01	60/G1	PT secondary Voltage Balance relay	Hitachi	SDV3-W-3E2
NP-01	50/BF1	Generator Breaker Failure relay	Hitachi	U0-T21-T21-B1
NP-01	62-2/G1	Time Delay operating relay	Hitachi	SM
NP-01	62/BF1	Time Delay operating relay	Hitachi	SM
NP-01	86/G	Lockout relay	Hitachi	UE-81A
NP-01	86-1/G	Lockout relay	Hitachi	UE-81A
NP-02	87-1/T1	Main Transformer and IPB differential relay	Hitachi	SYT-3E1
NP-02	87/T1	Main Transformer Differential relay	Hitachi	SYT-3E1
NP-02	87/T1A	Unit Aux. Transformer Differential relay	Hitachi	SYT-3E1
NP-02	51 N/T 1	Main Transformer Ground Fault relay	Hitachi	IO-L-B1
NP-02	51N/T1A	Unit Aux Transformer Ground Fault relay	Hitachi	IO-C-B1 IO-CI-B1 SG-X-C1
NP-02	50/51/T1A	Unit Aux. Transformer Over-current relay	Hitachi	IO-CI-B1
NP-02	64/B1	Bus Ground Fault relay	Hitachi	SG-X-C1
NP-02	25	Synchronizing Check relay	Hitachi	SN-C-2E1
NP-02	62-1/1B1 62-2/1B2	Time Delay Operating relay	Hitachi	SM
NP-02	51F/EX1	AC Exciter protection relay	Hitachi	IO-CIA-4B1



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NP-02	86/T1	Lockout relay	Hitachi	UE-81A
NP-02	86-1 /T 1	Lockout relay	Hitachi	UE-81A
NP-02	86/TA	Lockout relay	Hitachi	UE-81A
NP-03	64-1A/G1	Generator Ground Fault	Hitachi	IGV-D1
NP-03	64-1B/G1	Generator Ground Fault	Hitachi	RAGEA
AVR cubicle	64F/G1	Generator Field Ground Fault relay	Hitachi	SG-C-D1
AVR cubicle	64F/EX1	AC exciter field ground fault relay	Hitachi	SG-C-D1

Protection Relays Installed in Protection Panel for GTG 2, 4 & 8

Exist. Panel	Existing Device no	Protection Function	Existing make	Existing Type
NP-01	87 / G2	Generator differential relay	Hitachi	IY-B1
NP-01	8 7-1/ G2	Generator differential relay	Hitachi	IY-B1
NP-01	59/81-1/G2	Over excitation relay (V/f relay)	Hitachi	SVF-E1
NP-01	59/81-2/G2	Over excitation relay (V/f relay)	Hitachi	SVF-E1
NP-01	40-1/G2	Loss of excitation relay	Hitachi	UE-E1
NP-01	40-2/G2	Loss of excitation relay	Hitachi	UE-E1
NP-01	51V-G2	Generator protection backup relay- (Over current relay with voltage restraint)	Hitachi	IOV-C-B1
NP-01	32-G2	Reverse power relay	Hitachi	IH-C-B1
NP-01	46/G2	Negative phase sequence relay	Hitachi	IPO-SC-2G2
NP-01	2 7/ B2	Generator bus aux relay	Hitachi	MM4XP
NP-01	60/G2	PT secondary voltage balance relay	Hitachi	SDV3-W-3E2
NP-01	50/BF2	Generator breaker failure relay	Hitachi	U0-T21-T21-B1
NP-01	62-2 / G2	Time delay operating relay	Hitachi	SM
NP-01	62 / BF2	Time delay operating relay	Hitachi	SM
NP-01	86/G	Lockout relay	Hitachi	UE-81A UE-81A SYT-3E1 10-C-B1 IO-CI-B1 SG-X-C1 SN-C-2E1
NP-01	86-1/G	Lockout relay	Hitachi	UE-81A
NP-02	87/T1A	Unit aux. transformer differential relay	Hitachi	SYT-3E1
NP-02	51N/T1A	Unit aux transformer ground fault relay	Hitachi	10-C-B1
NP-02	50/51/T1A	Unit aux. transformer over current relay	Hitachi	IO-CI-B1
NP-02	64/81	Bus ground fault relay	Hitachi	SG-X-C1
NP-02	25	Synchronizing check relay	Hitachi	SN-C-2E1
NP-02	62-1/1B1 62-2/1B2	Time delay operating relay	Hitachi	SM
NP-02	51F/EX1	AC exciter protection relay	Hitachi	IO-CIA-4B1

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NP-02	86/T1	Lockout relay	Hitachi	UE-81A
NP-02	86-1/T1	Lockout relay	Hitachi	UE-81A
NP-02	86/TA	Lockout relay	Hitachi	UE-81A
NP-03	64-1A/G2	Generator ground fault	Hitachi	IGV-D1
NP-03	64-1B/G2	Generator ground fault	Hitachi	RAGEA
AVR cubicle	64F/G2	Generator field ground fault relay	Hitachi	SG-C-D1
AVR cubicle	64F/EX2	AC exciter field ground fault relay	Hitachi	SG-C-D1

2. The new relays and other auxiliary devices shall be installed in the existing panels. Modifications required in the existing panels for installing the new protective relaying system shall be part of the scope under this contract.

The relays 64-1A/G1, 64-1B/G1 (For GTG-1, 3 & 7) and 64-1A/G2, 64-1B/G2 (For GTG-2, 4 & 8) i.e. generator ground fault relay presently available in corresponding panel NP-03 are to be accommodated in the new panel, leaving panel NP03 unaffected in present position. The openings for the replaced relays shall be closed by blanking plates.

The generator field ground fault relay and AC exciter field ground fault relay 64F/G1, 64F/EX1 for GTG-1 and 64F/G2, 64F/EX2 located in corresponding AVR cubicles are to be replaced with new relays in their present locations. Any modification in existing panel for accommodating the new relays is included in scope of works.

New lockout relays will be provided in the protection panel. The lockout relays shall be separate from multifunction relays and shall be of 'Electroswitch' make.

- 3. Only the protection relays of make ABB, SIEMENS, ALSTOM (AREVA) or GE are acceptable. The relays shall comply with IEC 61850 communication capability.
- 4. Contractor shall survey and study the existing protection scheme and offer suitable system with relays of the acceptable make.

The installation of new protection systems and equipment shall include all related work on existing systems to provide satisfactory interfaces and overall integrated systems. All work must be planned to complete the interconnections and finalize the installation during a limited outage of the associated facility.

5. Instrument transformer ratios and instrument transformer secondary circuit connections shall be changed as required for the new protective relay circuit configurations implemented under this Contract. The existing electromechanical relays for differential protections make use of three-wire connections through (star-delta) auxiliary CTs installed in the 115 kV switchgear building. Since the new microprocessor based multifunction relays require four (4) wire CT connections, this requires laying of additional cables from the 115 kV Switchgear building up to the GTG Control Cubicles where the protection panels are located. The cables shall be laid in existing duct banks and in cable trays along the existing pipe racks.

CT connections from the 115 kV Switchgears up to the new protection relays shall be four (4) wires - three phases and common neutral for each CT, thus eliminating the use of Auxiliary CTs. All related works and material shall be part of the scope of supply under this contract.





<u>Note</u>: - The bidders shall quote unit price per meter length for installation of cable for extension of CT leads separately for installation along the existing duct banks and for installation in cable trays along the pipe racks.

The approximate lengths of cable run (route length) are as follows:

From Building # 23 to Central Control Building (CCB) basement in existing duct bank - 200 m.

From CCB basement up to service rack location, in existing duct bank - 50 m.

In cable trays on service rack - 500 m

From service rack location to GTG local control cubicle, in existing duct bank/trench - 100 m.

- E. The new protective relaying systems shall be furnished with interface and devices as required to integrate with existing control, protection, SCADA system and equipment. Under no circumstances shall modifications and additions to existing systems and equipment be permitted to degrade the performance of systems and equipment.
- F. The design and supply of the protective relay systems shall include but not limited to the following:
 - Manufacturing and supply of major components and associated accessories for the protective relaying system. Implementation of manufacturer's standards and otherwise specified quality control, inspection and testing of products in accordance with applicable standards.
 - Preparation of specifications and detailed design drawings showing complete systems and schemes
 including details of integration with existing systems. The design drawings include protection one line
 diagram and schematic/wiring diagrams. The protection one line diagram shall be A1 size drawing and
 the schematic/wiring diagrams shall be in sets of A3 size drawings.
 - 3. Preparation of shop drawings.
 - 4. Recommended relay settings for all relays complete with calculations and coordination shown on time current curves in view of the existing setting on the system. On completion of commissioning the system, the contractor shall submit to MARAFIQ the final relay settings together with signed hard copies and soft copy of the relay configurations.
 - 5. Preparation of operation and maintenance manuals and As-built drawings.
 - 6. Certification of specification compliance for all products and test certificates including certification of the applicability of protection equipment for integration with existing schemes and systems.
 - 7. Delivery of all materials and equipment to the installation site including unloading and setting.
 - 8. Special tools required for the initial installation and future maintenance.
- G. The installation of the protective systems shall include the following:
 - 1. All work required for installation of new protective relays, associated auxiliary equipment and related circuitry necessary to establish complete and functioning systems.
 - Implementation of all manufacturers' standards, quality control, inspection and testing procedures.
 - Commissioning and energization of the protective relay systems and panels including setting and testing all protective devices in accordance with relay setting documents.
 - 4. Preparation of "As-Built" drawings including revision of affected existing drawings to "As-Built" conditions. Some of the drawings for existing systems will be completely replaced by the new system drawings such as protective relaying one line diagram and wiring/ schematic diagrams. Contractor shall study the existing drawings in detail to achieve the similar functionality and interfaces, as a minimum.







5. A detailed cut-over plan to ensure that unscheduled power outages will not occur. The plan shall provide a full work sequence schedule with duration of all work activities shown. The plan shall be submitted to Marafiq for approval at least three (2) months prior to beginning of work in this area.

1.1 FACTORY TESTS

- Perform factory tests in accordance with approved test plans and procedures that conform to applicable standards referenced in this specification including a full functional acceptance test of relays to demonstrate acceptable operation.
- Submit test procedures to MARAFIQ for approval at least six (6) weeks prior to testing. Test procedures shall include test descriptions, test equipment descriptions, test sheets, calculations and minimum/ maximum test and performance values to be used in determining the acceptability of the equipment. The Contractor shall provide written notification to MARAIQ at least 4 weeks in advance of the test date.
- 3. Upon completion of testing, submit four (4) copies of certified reports attesting that each test was performed in accordance with approved test procedures. The report for each test shall include the date of performance and name of the person in charge of the test.

1.2 TRAINING

- A. A minimum of one week training for operation and maintenance of protection relay systems shall be provided in or out of Yanbu for minimum of five (5) MARAFIQ personnel.
- B. Each person trained shall be provided with a full set of the course materials.
- C. The training shall be designed to:
 - 1. Enable maintenance staff to perform maintenance of the equipment by trouble-shooting methods and procedures leading to the identification and replacement of faulty parts, modules or units.
 - 2. Enable maintenance staff to perform routine maintenance of the equipment by way of electrical adjustments and/or replacement of parts.
- D. The training duration shall be one week (5 working days). Two (2) months prior to project completion date the Contractor shall submit to MARAFIQ for review and approval:
 - 1. List of course
 - 2. Course outline
 - 3. Course material
 - 4. Schedule
 - 5. Instructors' name and qualification

E. Course Material

The course material shall be assembled in 3 ring binders.

For On-site Training course, six (6) sets of course material shall be provided one for each person attending the training plus one (1) additional set. Each set of course material shall contain in addition to the training material, the original printed documents of technical bulletins, pamphlets/ catalogs and instruction manuals.







2. MATERIAL SPECIFICATION AND INSTALLATION PROGRAM

2.1 MATERIALS

2.1.1 PROTECTIVE RELAY SYSTEMS

- A. General requirements for protective relay systems include but not limited to the following:
- 1. All equipment and devices shall be that which are customarily classed as utility grade and has widespread use and acceptance by electric utility companies.
- 2. Relay systems and equipment shall be microprocessor based numerical type/ multifunction and comply with the requirement to coordinate and integrate with existing systems and equipment.
- 3. Relay systems and equipment shall be designed and configured to facilitate tests and checks at system and component levels without removing power equipment from service.
- 4. Relay systems and equipment shall be designed to provide isolation and separation between redundant equipment and functions. Test switches, separate control power sources, separate trip circuits and separate communication channels shall permit the removal from service of redundant equipment without affecting the operation of the power transmission circuits.
- 5. Relay systems and equipment shall be electromagnetically compatible with each other and with the substation environment.
- 6. Monitor each trip circuit voltage past the last fuse, disconnect switch or circuit breaker in the circuit and provide contacts for alarm. Also monitor each circuit breaker trip coil, lockout relay coil and auxiliary tripping relay coil and provide contacts for alarm.
- 7. Provide vivid, positive indicating targets for each protective device operation/trip wired to operate in the event of actual alarm/trip.
- 8. Current and potential transformer quantities, ratios, and ratings for output power, burden and accuracy, as shown on Contract or reference drawings, shall be verified for suitability of application with the protection systems required by this Section. The instrument transformer characteristics and quantities shall be modified as required by the protection systems.
- 9. Contractor shall provide along with the main relays the software of all type of relays for the purpose of communication with relay, change of setting parameters, downloading the disturbance records, etc.

A. PANELS

The new protective relaying system shall be installed in the existing panels where the existing equipment shall be removed. The front panels/doors may be replaced or modified for installing the new relays and other equipment.

Guidelines for design/wiring of protective relaying panels include:

- 1. Interior nylon raceways with covers. Provide separate raceways for internal wiring and entrance of external cables.
- 2. Terminal blocks to terminate each conductor leaving the panel and to terminate spare control switch contacts. Provide 20% spare terminals.
- 3. Modular terminals assembled as terminal strips or molded, one piece, 12 circuit terminal blocks. Insulation material to be high-impact resistant phenolic or appeared equal Terminal hardware to be



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plated brass with plated brass washer and screws. Provide white terminal marking strips. Provide 600V, 20A ratings.

- 4. Current circuit terminal blocks with circuit shorting provisions.
- 5. Potential circuit terminal blocks with slide—link disconnecting terminals.
- Molded case circuit breakers, fuses or disconnect switches with auxiliary alarm contacts for disconnection of each auxiliary or control power and instrument potential source at the panel.
- 7. Interior light fixture with door switch.
- 8. In each panel provide a 120 VAC, 15A outlet for relay test set supply.
- 9. Space heater with thermostat.
- 10. Internal wiring of flexible, multi-stranded, copper with flame retardant, 90° C, 600V insulation. Control wiring of single conductor with minimum 1.5 sq. mm size. Instrumentation wiring of shielded twisted pairs with minimum 1.5 sq. mm. size cables with overall shield. Minimum conductor size for current transformer leads shall be 2.5 sq. mm. Minimum conductor size for voltage transformer leads shall be 1.5 sq. mm.
- 11. Wire terminals with ring tongue and nylon insulating sleeve. Install with compression indent tool,
- 12. Wire tags on interior wiring and field cables terminated in panel. Provide heat shrink tag material with permatized, non-smearing lettering or approved equal. Hand lettering is not acceptable.
- 13. Terminal block and terminal identification.
- 14. Nameplates:
 - a. All panel, cabinet and rack mounted devices such as relays, control switches, instruments, meters, circuit breakers and fuses shall be suitably identified with nameplates showing device name and device number. Nameplates for fuses shall also identify the current rating. Each panel, cabinet and rack shall also be identified with a nameplate. Flush mounted devices shall have nameplates on both the interior and exterior surfaces. Exterior engravings shall be in both English and Arabic. Interior engravings shall be in English.
 - b. Nameplates shall be 25 mm high minimum. Nameplates shall be laminated plastic engraved with black letters on a white background. Engraved characters shall be 4 mm high minimum. Engraving shall be in accordance with approved nameplate engraving schedules which follow device identification shown on approved shop drawings.
 - c. Nameplates shall be secured to panel exteriors and internal sub panels with stainless steel screws or mechanical fasteners. Double sided adhesive tape may be used to fasten name plates on the interior surface of panel and cabinet doors only.

2.1.2 QUALITY ASSURANCE

Referenced Standards: comply with applicable requirements of standards of each Institution listed below. Other organizations' standards equivalent to those listed below may be substituted after approval by the MARAFIQ. Two English language copies of each proposed substitute standard shall be submitted for review. Applicable standards shall include but not be limited to those listed below by document number.

1. American National Standards Institute (ANSI)

C37.90.1989 Standard for Relays and Relay Systems Associated with Electric Power Apparatus
C37.90.12002 Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay

Systems Associated with Electric Power Apparatus.

C37.91-2008 Guide for Protective Relay Applications to Power Transformers

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C37.97.1979	Guide for Protective Relay Applications to Power System Buses
C39.1-1981	Electrical Indicating Instruments
C62.41-1991 C63.12-1987	Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits Recommended Practice for Electro-magnetic Compatibility Limits.

2. Institute of Electrical and Electronics Engineers (IEEE):

242-1986	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
789-1988	Standard for Performance Requirements for Communications and Control Cables for Application in High Voltage Environments.

3. International Electro technical Commission (IEC):

255 Measuring Relays and Protection Equipment

4. National Electrical Manufacturers Association (NEMA)

Any conflict between this specification and the referenced codes and standards and contract reference documents shall be brought to the Owner's attention for written resolution.

2.1.3 SUBMITTALS

- 1. Test Reports: Submit test reports and certification of tests for manufacturer's factory tests. Test reports shall show compliance with applicable standards. Submit field test plans and field test reports.
- 2. Design Drawings and Shop Drawings: Submittal of drawings shall include the following as minimum:
 - 1. Protective Relaying One Line diagrams showing trip scheme and alarm scheme.
 - 2. Three-line diagrams for current and potential circuits.
 - 3. Schematic/Wiring diagrams for each panels.
 - 4. Connection and interconnection diagrams.
 - 5. Protection and control device internal schematic and external connection drawings.
 - 6. Contact schedules for control switches, lockout relays and auxiliary relays including timers.
 - 7. Cable schedules.
 - 8. Panel and cabinet layout, equipment arrangement, fabrication and dimensional details.
 - 9. Materials list.
 - 10. Inspection and Test Plans.
- 3. Calculations: Submittal of calculations shall include the following as a minimum:
 - 1. Equipment application calculations including instrument transformers.
 - 2. Relay setting calculations including device settings and one or more checkpoints.
- 4. Product Data: Submit manufacturer's specific catalog data for all equipment furnished.

2.2 INSTALLATION

2.2.1 INTEGRATION WITH EXISTING SYSTEMS









- A. The installation of new protection systems and equipment shall include all related work on existing systems to provide satisfactory interfaces and overall integrated systems. All work must be done during a limited outage of the associated facility.
- B. Instrument transformer ratios and instrument transformer secondary circuit connections shall be changed as required for new circuit configurations implemented under this Contract.

2.2.2 <u>INSTALLATION</u>

- A. Disconnect and remove the existing protection system and its auxiliaries which are not usable with new arrangement.
- B. Install new protective relaying equipment in the existing panels. The existing panels are installed in Local Control Cabinets as indicated in the reference drawings.
- C. Mount, anchor and fasten all equipment to provide secure and sturdy installations.
- D. Install interconnecting control cables, wiring and raceway systems as required.
- E. Use existing embedded and underground raceways/ duct banks and cable racks in MYASPP site wherever possible.

2.2.3 TESTING AFTER INSTALLATION

- A. Upon completion and prior to final acceptance, each component of each system shall be tested to the complete satisfaction of MARAFIQ who reserves the right to witness all tests. The Contractor shall provide test equipment/instrumentation and accessories necessary for testing and commissioning of all equipment and systems. At least 6 weeks before testing, the Contractor shall submit for MARAFIQ approval, all necessary calculations of relay settings, coordination curves and test procedures, as required to determine conformance with specifications.
- B. The test procedures shall contain references to applicable drawings and descriptions of test equipment, tests and checks together with minimum/maximum test and performance values conforming to applicable standards as required to verify the acceptability of equipment and installation including the following:
 - 1. Check for completeness.
 - 2. Checking that all connections and identifications are made in accordance with the relevant drawings.
 - 3. Setting and calibrating relays in accordance with contractor provided setting sheets that conform to Contractor provided coordination studies.
 - 4. Voltage tests on auxiliary circuits as specified in the applicable standards.
 - 5. Verification of current transformer ratio and polarity by primary injection of all cores both used and unused.
 - 6. Verification of correctness of current circuits to all panels and relays by secondary current injection at current transformer secondary terminals.
 - 7. Operation/Functional tests of all protective and control circuits to ensure correct operation of relays, circuit breakers, interlocks and local and remote alarm indication including:
 - (a) Trip tests through all relays as well as inter-tripping through new protection schemes.
 - (b) Complete tests of new protections including standalone and integrity.
 - After energization, on load measurement shall be taken on each relay to verify correct connections and input quantities.



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- C. Upon completion of all testing the Contractor shall submit four copies of a certified report attesting that each test has been performed in accordance with the approved test procedures. The report for each test shall include the date of performance and name of the person in charge of the test.
- D. Incorporate all factory and field test reports in Operation and Maintenance manuals.

2.3 LIST OF REFERENCE DRAWINGS

1.	T&D-EE-A0-016	Single line diagram of MYAS power system.	
2.	006Q-P01-673	One line diagram of GTG and unit substation	
3.	006S-P06-104	One line diagram for differential protection relay	
4.	331DF15182	Outline of control compartment	
5.	331QF27616	Arrangement of protection relay panel and instrument panel	
6.	331DF26083	Elementary Diagram for Even number GTGs	
7.	331DF22962	Elementary Diagram for Odd number GTGs	
8.	Generator & Transformer Data		

9. Name plate detail for unit auxiliary transformer

Note: Above drawings are for indicative purpose. Any other data required for the purpose of estimation of job works can be received from MARAFIQ upon specific request or site visit.







SECTION – IV L REPLACEMENT OF 600V DRAW OUT METAL CLAD SWITCH GEAR FOR GTG 1,2,4,7 & 8









I. SCOPE OF WORKS

1. Brief Description of the Work

A. The work under this contract is to complete replacement and modify the existing system & includes the work of Engineering, Design, Supply, Transportation, Fabrication, Installation, testing and Commissioning of three (3) outdoor type 600 Volts draw-out Metal Clad Switchgears, floor mounted, using stored energy type air circuit breakers, for any three (3) of Gas Turbine Generator (GTG) units; connecting and retrofitting with an existing secondary units auxiliary transformer 1500kVA, 4.16kVA/480V, 3-phase. Disconnection, dismantling and safe disposal of the existing switchgears. Reconnections of the power feeders to the transformers and local and remote control wiring of new switchgears in the field at power generation facilities.

New switchgear shall utilize the state of the art of the latest technology and components that are functionally compatible with existing components and equipment.

Contractor shall be totally responsible for all activities necessary to produce engineering and design documents and installation and construction works that are acceptable to owner. All works shall be carried out in accordance with contract documents.

- B. The Low Voltage draw-out type Metal Clad Switchgear shall be an outdoor consisting of free standing enclosed steel structure, complete with main and feeders, draw out type air circuit breakers rated 2500Amps for main breaker and 4 x 1200Amps for outgoing feeder breakers, controls, relays, wiring and auxiliary equipment similar to existing system in accordance with the individual technical specification provided in the relevant section.
- C. Fabrication and installation of the Draw-out Metal Clad Switchgear structure complete with individual draw-out type air circuit breakers, incoming bus connections and feeders cables connections. The entire Metal Clad Switchgears with individual circuit breakers compartments enclosed with sheet barriers and equipped with primary and secondary contacts, draw-out rails, and mechanical interlock, stationary and removable elements and accessories installed in accordance with the individual technical specifications provided in the relevant sections.
- D. Disconnect, tag and reconnect all of the existing incoming and outgoing feeders to the new switchgears, as well as local and remote control and monitoring wiring in UCS marshalling, as required.
- E. All the loads presently supplied from the existing switchgear will be reconnected to the new switchgear. The existing cables & conduits disconnected from the existing switchgear shall be reconnected to the new switchgear. No joints are allowed in cables.
- F. Provide and install grounding system for the new switchgear and integrate with existing ground grid.
- G. Protection and relay settings for the new switchgear, testing and commissioning.
- H. Shift and deliver safely all the dismantled material from the site to MARAFIQ lay down area or warehouse as directed by MARAFIQ.
- Miscellaneous elements of the work shall include but not be limited to the following:
 - 1. Drawings associated with the existing facilities and equipment shall comply with the following requirements:
 - a. The new drawing shall be similar to the existing, like drawing size, content and format. MARAFIQ drawing number shall be assigned in a continuation of the sequence of drawing numbers for existing sub sets into which new drawings must be integrated.
 - a. When the design work is finished for Low Voltage Switchgear replacement the entire set of shop drawings, including new drawings shall have the same organization and cohesiveness as before the design work started.
 - b. The contractor shall be responsible for research and identify MARAFIQ / Royal Commission documents and drawings necessary to work but not be included with the documents. The contractor shall be responsible for retrieval of those documents.
 - Site survey and field verification of existing facilities to develop detailed design work.

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2. Technical Requirements:

A. Professional Services

- The contractor shall have full responsibility for the detailed engineering and design of all required items, elements and systems necessary for complete operable reliable and functional 600V new draw-out switchgear for GTG units.
- The contractor shall provide all required professional services for the detailed design of civil, structural, electrical and facility, systems and equipment. Included is the preparation of final construction drawings and specifications; design analysis; and other required contract documents as well as providing all necessary and related professional services in connection with the design work as specified.
- 3. The engineering and design effort requires complete familiarization with the existing facilities, elements and components of the power system. Complete sets of technical documents covering these equipment and system and the interfaces must be on hand with the contractor throughout the engineering and design phase in order to successfully integrate the required new system and equipment. It is the contractor's responsibility to become intimately knowledgeable of the existing systems and equipment to engineer and design the complete switchgear consistent with the existing design philosophy and compatible with interface requirements.
- 4. The main objective of the engineering and design effort shall be to satisfy the system requirements and concurrently achieve safety, reliability, continuity of service, and ease of operation and maintenance.
- B. As part of the complete design development responsibility, the contractor shall assume the following as minimum:

If the design requires additional components for correct and safe operation then the contractor shall furnish and install those components either in the existing or in the new system.

- 1. The contractor shall be responsible for obtaining all required information from existing design documents, operation and maintenance manuals and specification as necessary to perform the design.
- The contractor may use the information on existing as-built drawings to the extent possible in his design. However, it shall be the responsibility of the contractor to verify in the field the as-built conditions wherever necessary, especially for interfaces, and prepare complete sets of comprehensive new design drawings.
- 3. The contractor's responsibility shall also include a verification of adequacy of existing systems, equipment and extension of these facilities to the new system and equipment.

3. MATERIAL SPECIFICATION AND INSTALLATION PROGRAMME

3: MATERIAL & EQUIPMENT SPECIFICATIONS

3.1 DESCRIPTION OF WORK



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The Contractor to provide Metal Clad Switchgear and all related materials and equipment that are new, of the type and quality specified. Materials and equipment shall be manufacturer's standards products in compliance with referenced standards and adequately described by published product information. It includes but not limited to the following.

A. The Contractor shall, as part of his full responsibility scope, check the ratings and/or sizes of those components whose ratings or sizes are specified in the Contract documents. When this check indicates that the specified ratings or sizes are not adequate then the Contractor shall make the necessary changes at no cost to the MARAFIQ.

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- B. The work shall consist of the engineering, design, manufacturer, supply, testing and installation of the outdoor type 600V draw-out Metal Clad Switchgear for Low Voltage auxiliary services. Requirements of this section shall be incorporated in the design, fabrication and testing of the equipment.
- C. The supply of the Low Voltage Switchgear with all associated protection, controls, metering and accessories shall include the following:
 - 1. Manufacturing of major components of the equipment.
 - 2. Manufacturing and/or supply of all associated accessories including support structures.
 - 3. Preparations of Operation and Maintenance Manuals.
 - 4. Delivery of all materials and equipment to the site including loading, unloading, haulage and installation inside the building.
 - 5. Preparation of Specifications, Design and Shop Drawings.
 - 6. Preparation of Installation details drawings.
 - 7. Preparation of commissioning and start-up manuals.
 - 8. Verification of all specified sizes and quantities for system and components.
 - 9. Implementation of all manufacturer's standards and otherwise specified quality control, inspection and testing of products in accordance with applicable standards.
 - 10. Testing, Commissioning and Energization of the Switchgear and related equipment.
 - 11. Special tools required for the initial installation and future maintenance.
 - 12. Commissioning spare parts.
 - 13. Recommended Operational Spare Parts.
- D. Preparation of design and shop drawings: The design shall follow the existing system philosophy unless specified otherwise. This includes but not limited to the following:
 - 1. Design and shop drawings for the new switchgears as well as revising the existing drawings of related systems to which the switchgear will be integrated and interfaced. The existing related drawings shall be revised to show the changes required due to replacement of the old switchgear with new one.
 - 2. As part of the design work, contractor is responsible for research and retrieval of all related drawings and other information from MARAFIQ technical Library, as required for the design and integration of the new switchgear.
 - 3. Preparation of protection coordination studies for the new equipments and to coordinate with existing upstream and downstream systems. In case modification of settings for existing systems is necessary, the contractor shall modify such settings and related documents.
 - 4. Sizing and application calculations for systems and components and verification of all specified sizes and quantities.
 - 5. Preparation of installation data and drawings, cut-over plan etc.
 - 6. Preparations of "As-Built" drawings including revision of existing drawings original to "As-Built" condition.
 - 7. The design, including configuration of switchgear protection, control and metering systems shall follow the precedence of existing "like" systems.
- E. The new switchgear shall have the facility to ground the bus bar through the grounding switch to carry-out maintenance activities. The grounding switch control shall be interlocked with Main Incomer Breaker.
- F. The design, including configuration of switchgear protection, control and metering systems and equipment shall be compatible with existing systems.

3.2 **AVAILABILITY OF SPARE PARTS**

The contractor shall guarantee the availability of spare parts of the Metal Clad Switchgears and all related equipment for about 15 years of the equipment life in order to avoid early obsoleteness.

3.3 QUALITY ASSURANCE

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- A. Referenced Standards: All materials and equipment of the draw-out Metal Clad Switchgear including all components shall be designed, manufactured and tested in accordance with the latest issues of relevant International Electrochemical Commission (IEC) and/or ANSI standards. When IEC standards are not relevant or in existence, use other applicable standards listed below. Internationally accepted standards of the manufacturer's country may be approved for use provided they are equivalent to applicable standards other than listed below; a comparison table shall clearly show the equivalency between substitute standards listed below. Any conflict between the specification and reference codes and standards shall be brought to MARAFIQ attention for a written resolution. Comply with applicable provisions of the following latest standards except as otherwise specified.
 - 1. International Electro-technical Commission (IEC):

IEC158-2: Low Voltage Control gear Part 2: Semi-Conductor Contracts

IEC265: High Voltage Switches, Part-1, High Voltage Switches for Rated Voltages above 1kV and

less than 52kV

IEC5-1: Direct acting indicating Electrical Measuring Instruments and their accessories

IEC1 58 3: Low Voltage Control gear Part 3: Additional Requirements for Contractors Subject to

Certificate

IEC2 9-1: Low Voltage Fuses, Part 1: General Requirements

IEC420: High Voltage Alternating Current Switches fuses combination

IEC947-3: Low Voltage Switchgear and Control Gear, Part 3: Disconnect Switch and Fuse

Combination Units.

IEC947-41: Low Voltage Switchgear and Control Gear, Part 4: Contactors and Motor Starters

IEC947-5-1: Low Voltage Switchgear and Control Gear, Part 5: Control Circuit Devices, Switching

Elements

IEC439-1to5: Low Voltage Switchgear and Control Gear Assemblies

IEC947-2: Low Voltage Switchgear and Control Gear, Part 2: Circuit Breakers

IEC44-1: Instrument Transformers Part 1: Current Transformers

IEC73: Basic and Safety Principles for Man-Machine Interface, Marking and Identification

Coding Principles for Indication Devices and Actuators

IEC694: Common Specifications for High Voltage Switchgear and Control gear Standards

IEC947-1: Low Voltage Switchgear and Control gear, Part 1: General Rules

2. Institute of Electrical and Electronics Engineers (IEEE)

IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power System.

C37.04 Rating Structure for AC High-Voltage Circuit Breakers
C37.06 Schedules of Preferred Ratings and Related Required
Capabilities for AC High-Voltage Circuit Breakers

Rated on a Symmetrical Current Basis

C37.07 Interrupting Capability Factors for Reclosing Service

For AC High-Voltage Circuit Breakers

C37.09 Test Procedure for AC High-Voltage Circuit Breakers

C37.010 Application Guide for AC High-Voltage Circuit

Breakers Rated on a Symmetrical Current Basis

C37.011 Requirements for Electrical Control for AC High Voltage Circuit Breakers Rated on a Symmetrical

Voltage Circuit Breakers Rated on a Symmetrical Current Basis and a Total Current Basis

C37.012 Guide Specifications for AC High-Voltage Circuit

Breakers Rated on a Symmetrical Current Basis and a Total Current Basis.

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C37.20.2 Metal-Clad and Station type Cubicle Switchgear.

3. American National Standards Institute (ANSI)

ANSI C37 13: Requirements for Instrument Transformers

ANSI C37 17: Trip Devices for AC and General Purpose DC Low-Voltage Power Circuit Breakers



ANSI C37 16: Preferred Ratings, Related Requirements and Application recommendations for Low

Voltage Power Circuit Breakers and AC Power Circuit Protectors

ANSI C37 20: Metal Enclosed Low Voltage Power Circuit Breaker Switchgear

ANSI C37 50: Test Procedure for Low Voltage AC Power Circuit Breaker used in Enclosures

ANSI C37 51: Conformance Testing of Metal Enclosed Low Voltage AC Power Circuit Breaker

Switchgear Assemblies

4. National Fire Protection Association (NFPA)

NFPA 70: National Electrical Code (NEC 2011)

5. Royal Commission for Jubail and Yanbu:

a. Royal Commission Electrical Code (RCEC).

b. General Design Criteria and Technical Guidelines

3.4 SUBMITTALS

A. Design Submittals: The design submittal includes all Design Analysis Reports which shall be written explanation of the design basis for the equipment proposed.

B. Design Drawings & Shop Drawings: The contractor shall prepare and submit design shop drawings to MARAFIQ for review and approval. The drawings submittal shall include all engineering and vendor drawings required to implement the job. A drawing control list shall also be prepared for all drawings to be submitted by the contractor. The list shall indicate when each of the drawings will be submitted during the design stage.

C. Preparation of design and shop drawings

The design shall follow the existing system philosophy unless specified otherwise. This includes but not limited to the following:

- Design and shop drawings for the new switchgears as well as revising the existing drawings of related systems to which the switchgear will be integrated and interfaced. The existing related drawings shall be revised to show the changes required due to replacement of the old switchgear with new one.
- As part of the design work, contractor is responsible for research and retrieval of all related drawings and other information from MARAFIQ Technical Library, as required for the design and integration of the new switchgear.
- Preparation of protection coordination studies for the new equipments and to coordinate with existing
 upstream and downstream systems. In case the modification of settings for existing systems is necessary,
 the contractor shall modify such settings and related documents.
- 4. Sizing and application calculations for systems & components and verification of all specified sizes and quantities.
- 5. Preparation of installation data and drawings, cut-over plan etc.
- 6. Preparation of operation and maintenance manual.
- 7. Preparation of "As-Built" drawings.
- 8. The design, including configuration of switchgear protection, control and metering systems shall follow the precedence of existing "like" systems.
- D. The Contractor shall also submit all sizing calculations done in the design stage and short-circuit rating verification for electrical equipment protection. Include in the submittal the type test certificates for shortcircuit and temperature rise withstand capabilities of the bus-bar and circuit breakers.
- E. As-Built Drawings: The contractor shall revise all modified existing drawings and submit As-Built drawings, clouded with the modified part of installations as per the As-Built of the new drawings.
- F. Miscellaneous and Others: The miscellaneous submittals, which will be required at various stages of the project work shall include, but not limited to the followings;
 - 6. Vendors product catalogs
 - 7. Installation Procedures
 - 8. Test Procedures and Plans
 - 9. Outline and General Arrangement dimensional dra







- 10. Layout and installation details
- 11. One-line diagrams
- Schematic/ wiring diagrams with termination and interconnection details with external equipments.
 Connections to external equipment shall indicate the continuation drawing number and termination details.
- 13. Revised existing drawings: Revise/modify all related existing drawings for existing systems to which the new equipment integrates or interfaces.
- 14. Preliminary Equipment List
- 15. Material/ parts list (Bill of materials)
- 16. Grounding plans
- 17. Nameplate schedule
- G. Calculations: Submittal of calculations shall include the following as a minimum:
 - 1. Equipment sizing / application calculations
 - 2. Fault current analysis and protection coordination study with Time Current Coordination curves.
- H. Product Data: Submit manufacturer's catalog material for all equipment furnished.
- I. Project submittals shall include, as a minimum, the following documents:
 - 1. Master / Overall Schedule.
 - 2. Submittal Drawing list
 - 3. Code and Standard list.
 - 4. Technical Clarification list
 - 5. Material Specification list
 - 6. Installation Schedule
 - 7. Safety Program
 - 8. Sanitation Program
 - 9. Security Program
 - 10. Quality Assurance Plan
 - 11. Emergency Response Plan
 - 12. Risk Assessment of the Project and Risk Register
 - 13. Monthly Progress Report
 - 14. Design submittal
 - 15. Shop Inspection Test Report
 - 16. List of Site Inspection and Test
 - 17. Test Procedure and Plan
 - 18. Test Inspection Record
 - 19. Commissioning Report
 - 20. Material Specification of Supplied Parts
 - 21. RSPL List for two Years
 - 22. As Built Drawings in Micro station J format
 - 23. O&M Manuals 3Copies
 - 24. Training Material and Record
 - 25. Spare Parts Data Sheets and Vendor Product Catalogs
 - 26. (As-Built drawings shall include all new cable, CB control diagram drawings, wiring terminal diagram etc. Any modification on existing drawings such as switchgear one line diagrams, control diagrams and wiring diagrams shall also be provided by CONTRACTOR). As-built drawing must contain the followings:
 - a. As-Built Stamp signed by the project engineer showing clearly his name and the date.
 - b. TITLE BLOCK (Official of MARAFIQ) showing the contract name & logo.
 - c. PROJECT TITLE, accurate description of the project.
 - d. DRAWING TITLE, accurate description of the drawing contents.







- e. SCALE of the drawing such as 1:500, Use (As Shown) in case of several scale used. {(N.T.S) is accepted **ONLY** for schematic diagrams). In addition to a BAR SCALE that helps should the drawing be reduced or enlarged for any reason.
- DRAWING NUMBER, consists of contract number, facility (WW-PW...Etc.) Discipline (Civil, Electrical...Etc) and drawing number as accurately described in the title block Bently File attachment (2). Each & every drawing MUST be identified by a UNIQUE DRAWING NUMBER regardless number of sheets illustrating series of drawings. Should the project be a continuation or extension of a current contract, the drawing number will follow the current series of drawings. (((CAD FILE NUMBER SHOULD BE THE SAME AS THE FULL DRAWING NUMBER))).
- REVISION number and accurate revision description. Revised parts of the drawing must be CLOUDED, stating the revision number adjacently, ONLY the latest revision number should remain clouded while the previous revisions clouds must be eliminated.
- NORTH ARROW, showing plant north and true North located at the upper right side of drawing.
- KEY PLAN, highlighting the project area.

4: PRODUCTS

4.1 **GENERAL**

- A. The switchgear shall be an outdoor type installation and mounted at an elevation less than 1000 meters above sea level in a seismic zone classification defined in MARAFIQ/ Royal Commission Building Code.
- B. The equipment shall include coordinated assemblies of incoming line from transformer and outgoing Low Voltage sections with auxiliary and transition compartments necessary to provide complete unit ready for installation, connection, and immediate service.
- C. The site conditions under which the switchgear and associated equipment are required to operate are as
 - 1. Room temperature, air conditioned (A/C)

32°C

Maximum room temperature if A/C fails (8hrs)

55°C

D. Ratings: Refer to ratings per attached reference drawings of the existing switchgea R. 1010223377

4.2 ARRANGEMENT AND CONSTRUCTION

otherwise.

- The switchgear shall consist of factory-assembled metal-clad equipment consisting of incoming line sections from existing power transformer 4.16kV/480V to a main incomer stored energy type air circuit breaker 2500Amps and four (4) branch stored energy type air circuit breakers of 1200Amps each.
 - The new switchgear provided shall fit in the space available in the switchgear room in the same location where existing switchgear is located.
 - 2. Adequate openings shall be provided for all conductors entering the panel.
 - 3. Terminal Connectors: Terminal connectors for power cable and ground cable entering the switchgear shall be furnished. Solder type terminals are not acceptable.
 - 4. Like parts of the switchgear and circuit breaker(s) of the same rating shall be fully interchangeable both electrically and mechanically so that where so interchanged, the circuit breaker(s) shall perform equally well in every respect.
 - 5. Bus bars shall be made of copper with welded type connections or tin plating at bolted type connections. The bus bars shall be braced to withstand 25 MVA symmetrical short circuit level.
 - Low Voltage switchgear shall be metal enclosed outdoor type product.

SWITCHGEAR SECTION:

 The low-voltage switchgear section shall consist of an assembly of free-standing enclosed steel structures complete with main and feeder draw out circuit breakers, controls, relays, wiring and auxiliary equipment. Each Structure shall contain individual draw out type air circuit breakers or income connections and feeder cable connections. The individual circuit breaker compartm



- completely enclosed with sheet steel barriers to segregate the breakers from adjacent compartment and buses. Switchgear shall include a draw type PT cubicle with under voltage relay and associated auxiliaries, etc. (Refer to attached Drawing No.006Q-P01-673 SLD of GT Gen. & Unit Substation).
- 2. Circuit breaker compartments shall be equipped with primary and secondary contacts, draw out rails, and a mechanical interlock to prevent insertion or withdrawal of the breaker when the breaker is in the close position. Maximum number of compartments per vertical section shall be three.
- 3. Each breaker compartment shall have hinged steel door arranged so that the door will open a minimum of 90°, with mechanical interlock to prevent the door from being opened when the breaker is in the closed position. Each breaker compartment shall be provided with a breaker draw out mechanism which will permit a tripped breaker to be moved from the connection position to test and disconnect positions with door closed.
- 4. Rear compartments shall be enclosed with removable covers.
- 5. Each vertical section of the switchgear shall be equipped with blank steel removable plates, top and bottom, to permit drilling or punching the plates for conduit entrance.
- 6. Main buses and bus taps shall be copper suitably supported and braced to withstand the available fault currents. Buses shall be silver-plated bolted connection points. Bus connections to the line-side terminals of the incoming supply breaker shall be segregated from the main switchgear bus by means of isolating barriers completely enclosing the buses. Buses shall be held rigidly within the structure by bus supports fabricated from materials which will maintain their physical and dielectric properties under the service conditions.
- 7. Nameplates: A nameplate shall be provided at the front upper part of each unit substation for identification. Nameplates shall be provided on the front of each compartment door for circuit identification. Nameplates shall be provided for circuit devices mounted within the unit substation, such as relays and other components. Circuit device nameplates shall show the functional number or other designation of the device. External nameplates shall be engraved in both English and Arabic. Internal nameplates shall be made of laminated plastic, engraved with black characters on a white background and shall be fastened with stainless steel screws. Safety / Warning signs shall be in English & Arabic.
- 8. Breaker Grounding Mechanism: Each breaker compartment and equipped space shall be equipped with a heavy-duty breaker frame grounding device. This device shall provide positive breaker frame grounding when the breaker is in either the test or operating position.
- 9. Types and settings of protective devices (relays, solid state tripping devices) shall be selected to achieve selectivity and provide backup protection.

4.3 AIR CIRCUIT BREAKERS

- A. Air circuit breakers shall be three-pole draw-out type. Feeder circuit breakers shall be rated 1200Amps minimum. All circuit breakers shall be complete with solid state phase and ground over-current tripping devices.
- B. The main circuit breaker shall be rated 2500Amps minimum and also be provided with an overload-alarm-trip with manual reset and target indicators switch. All switch contacts shall be wired to terminal blocks.
- C. Minimum interrupting rating of circuit breakers shall be 42,000 RMS symmetrical amperes with short time delay of 0.5 seconds for all breakers.
- D. The circuit breaker operating mechanism shall be electrically and mechanically trip free. Each breaker shall be provided with a manual closing device and visible position indicator. Each breaker shall have a racking mechanism which shall permit the tripped breaker to be racked from the connected to the test and disconnected positions with the breaker compartment door closed.
- E. A remote common alarm shall be provided at the local control room and also at the CCB to indicate when a control switch has been turned to the "local" position. Discrepancy indication shall be provided at the local control room and CCB for every remote controlled breaker to clearly indicate that the switch is in Local Position.

F. Breakers shall be provided with electrical/mechanical interlocks to prevent disconnecting the breaker when closed and prevent connecting the breaker when closed.

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- G. Circuit breakers shall be furnished with facilities for padlocking the breaker in the disconnected position with the breaker open. Facilities for multiple padlocks shall be provided.
- H. Breakers of the same rating shall be interchangeable. This will require identical wiring and auxiliary contact arrangement for each breaker even though all the auxiliary contacts may not be used for a breaker in the particular unit to which it is assigned.
- Breakers shall be capable of carrying rated full load current continuously without exceeding the temperature
 rise specified in IEEE and NEMA standards. Circuit breaker insulation shall be coordinated with that of the
 switchgear structure and shall be designated for use on a 600 volt system.
- J. Breakers main contact surfaces and all secondary device contact surfaces shall be silver to silver, designated and fabricated to be self-aligning and to resist burning and deterioration.
- K. Arc quenching and extinguishing devices (Deion Grids, Baffles, and Magnetic Arc Chutes) furnished shall be fabricated from non-hygroscopic material.
- L. Air circuit breakers (ACB) draw-out type complete with microprocessor based protective relay for Long Time, Short Time, Instantaneous & Ground fault (LSIG) protection, CT's, indicating lamps and associated auxiliaries.
- M. Circuit breakers shall meet the requirements of ANSI C37.13, 16, 17, & 50 and shall be UL 1066 listed and labeled.
- N. Local & remote operation requirements for each breaker shall be as indicated in the one line diagram and schematic diagram.
- O. The circuit breakers must indicate the exact position of the main contacts, the circuit breaker position, and the status of the charging springs of the front of the circuit breaker with the door closed and stationary.
- P. The breaker shall have trip units, sensors suitably rated to achieve the existing settings.
- Q. All necessary accessories for operating and interchanging breakers shall be furnished by the Contractor.
- R. The contractor should provide a suitable breaker lifter.
- S. Circuit breaker preferred manufacturer is ABB.

4.4 WIRING

- A. All interior wiring shall be neatly and carefully installed wiring gutters or using nylon wire ties and shall be terminated at terminal blocks plainly lettered or marked in accordance with the Contractor's connection diagrams. Extra flexible wire shall be furnished at hinge points.
- B. Switchgear units that are split for shipment shall be furnished with all wiring required to interconnect the switchgear units.
- C. Control and potential buses as required shall be 4 sq mm switchboard wire or larger installed at the rear of the instrument and control compartment.

4.5 **GROUNDING**

Each secondary unit substation shall be provided with a main copper ground bus not less than 51 x 6 mm in cross section, running throughout the length of the switchgear section near the bottom. All framework, metal enclosures, barriers, and non-current-carrying parts of equipment shall be securely grounded, and grounding connections shall be brought to the ground bus. The metal framework of the assembly may form part of the internal grounding circuit, provided a solid and uninterrupted path thereby assured; otherwise, grounding connections shall be furnished.

4.6 CURRENT SENSORS

- A. Current sensors used with solid-state over current trip devices shall have thermal and mechanical ratings and insulation class not less than those determined by the associated circuits.
- B. Output of the current sensors used with solid-state over current trip devices shall be coordinated with the associated trip devices to provide the required trip characteristics.

4.7 OVERCURRENT TRIP







- A. Breakers shall be equipped with 3-pole solid-state type over current tripping devices to provide interchangeable and independently adjustable over current and short circuit protection. Trip settings will be coordinated to provide selective trip over current protection. The Contractor shall furnish tripping devices with characteristics and trip ranges which will permit this coordination.
- B. Breaker shall be open-close indicator that shows "Close" when the breaker is closed and "Open" when the breaker is opened or tripped.
- C. Over-current trip device that can be fitted to one breaker include a solid state over-current trip device, which operates on secondary current of the CT's mounted on the breaker main circuit conductors, and a series connected directing-acting instantaneous trip device.
- D. Main, out-going and tie breakers shall be furnished with trip devices to provide long time delay, short time, instantaneous & ground fault (LSIG) protection, provided with microprocessor based protective relay or equivalent.

4.8 <u>INSTRUMENT TRANSFORMERS</u>

- A. Current transformer shall be provided with ratios determined by the contractor. Phase designation and polarity shall be clearly marked on each current transformer.
- B. Each switchgear section shall be provided with potential transformers. Potential transformers shall be draw out type, mounted in separate compartments, and shall be equipped with current-limiting fuses on both terminals of the primary. Secondary fusing shall be determined by the contractor. The draw out mechanism shall provide means of disconnecting the primary circuit before access can be obtained to the transformer or fuses.

CONTROL DEVICES

- G. Each switchgear section shall be provided with ground indicators, ground alarm, relays, indicating lights, and meters as required.
- H. The voltmeter switch shall have the capability of selecting phase-to-phase voltages when the potential transformer secondary is open-delta connected and phase-to-phase & phase-to-neutral when wye connected.
- Switches shall have pistol-grip handles for circuit breaker control and round notched handle for instrument control.
- J. The following relays shall be furnished, as minimum:

Device No.	<u>Description</u>
27	Bus voltage time delay
27X	Multi contact auxiliary tripping relay, self-reset, 125Vdc coil and contacts
64	Bus ground alarm relay overvoltage type, 120V continuous
74	Auxiliary alarm relay, 125Vdc coil & contacts



4.10 <u>ACCESSORIES AND SPECIAL TOOLS</u>

- A. All necessary accessories and special tools required for erection, inspection, testing & commissioning and future maintenance of the Low Voltage Metal Clad Switchgear shall be furnished by the contractor.
- B. The Contractor shall include as a minimum one set of accessory sets for the following:
 - Floor-running, crank-operated, breaker-lifting device, including operating hand crank and yoke suitable for lifting the breakers covered in this Specification.
 - 2. Removable closing handles for breakers of each size.
 - Set of special wrenches for breakers of each size.
 - Two portable test sets to test solid-state over-current tripping devices.

4.11 <u>FACTORY TESTS</u>





The Low Voltage Metal Clad Switchgear shall meet the requirements of all standard factory production tests. The Metal Clad Switchgears shall be tested after completely fabricated and shall subjected to and shall meet all requirements of the production tests listed in applicable NEMA and ANSI or IEC standards. MARAFIQ reserves the right to witness all factory tests.

5 **EXECUTION**

5.1 <u>INSTALLATION OF LOW VOLTAGE METAL CLAD SWITCHGEARS</u>

The installation of Metal Clad Switchgears shall be in accordance with Manufacturer's recommended procedure and applicable standards subject to MARAFIQ approval. The installation works for the Metal Clad Switchgears shall include but not limited to the following:

- A. The switchgears shall be installed per the approved design and shop drawings. All work shall be performed by qualified field personnel.
- B. The installation of the switchgears shall include all related work on existing systems to provide satisfactory interfaces and overall, integrated systems.
- C. The facilities available for lifting the heavy equipment shall be provided. Contractor shall be responsible for the completeness of the erected equipment and shall test and verify the operation of all components, assemblies, sub-assemblies, control and auxiliary devices.
- D. The Metal Clad Switchgears shall be installed in existing building for equipment associated with GTG's.
- E. Install all equipment in accordance with manufacturer's recommended practices and applicable standards.
- F. Install of grounding and bonding of electrical equipment and structure and with the existing grounding network.
- G. Perform related control wiring terminations in UCS marshalling cabinets and verify its configuration for control of breakers from UCS same as existing.
- H. Contractor shall be responsible for the completeness of the erected equipment and shall test and verify the operation of all components, assemblies, sub-assemblies, control and auxiliary devices.
- I. Contractor shall be responsible for installation of all AC and DC supplies and grounding conductors for grounding all the equipment to the existing ground grid.

5.2 <u>TESTING AFTER INSTALLATION</u>

- A. Site tests, in accordance with applicable standards, shall be carried out by the Contractor to ensure that the equipment and materials comply with the specifications and operational requirements. All tests are subject to witnessing by the MARAFIQ representatives.
- B. Prior to the schedule tests, the contractor shall submit to the MARAFIQ an outline of the plan and procedures to be used in performing the site inspections and site tests. This outline shall include a brief description of the tests equipment, connection diagrams, proposed tests and procedures, tests sheets, calculations, reference drawings and minimum/maximum test and performance values in conformance with applicable standards which will be used to determine conformance with the specification and acceptability of the equipment and installation.
- C. Upon completion of installation and prior to final acceptance, each component of each system shall be tested to the complete satisfaction of MARAFIQ. The Contractor shall provide all test instrumentation, equipment and accessories necessary for demonstration and putting into operation all switchgear parts. Before commissioning, the Contractor shall submit all necessary calculations of relay settings and coordination curves to the MARAFIQ for approval.
- D. The inspection and test procedure shall contain but not be restricted to the following:
 - 1. Check for completeness.
 - 2. Checking that all connections and identifications are made in accordance with the relevant schemes. Check all connections for tightness.
 - 3. Tests to verify the insulation resistance in the electrical main circuits. The circuits disconnected from existing switchgear and reconnected to the new switchgear shall be tested before energizing.
 - Voltage tests on auxiliary circuits as specified in the applicable transaction.
 - Verification of instrument transformer ratio and polarity and instrument transformer ratio

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- Operation tests for the various components, including interlocking, local and remote control, local and remote position indication, local and remote alarm indication, local and remote measuring and metering, etc. Current injection, as required, to verify proper operation of devices.
- Functional tests ensuring correct trip and close operation of relays, circuit breakers and local and remote alarm indication.
- 8. Circuit breakers shall be tested for rapid open-close operation.
- 9. Functional tests prior to energizing, ensuring correct operation of the entire protection system.
- 10. Testing of low voltage equipment with regard to insulation and phasing.
- 11. Setting and testing all protective devices per the relay coordination study data sheets. Test results shall be recorded and submitted as part of the Operation & Maintenance manuals and contract documents.
- 12. Verification of stipulated grounding resistance and compliance with recommendations of IEEE 142 and IEEE 80.
- 13. Dielectric tests on switchgear assemblies shall be performed. Test voltages shall be in accordance with IEC standards. Test shall not cause any insulation failure.
- E. Upon completion of all testing the Contractor shall submit four copies of a certified report attesting that each test has been performed in accordance with the approved test procedures. The report for each test shall include the date of performance and name of the person in charge of the test.
- Incorporate all factory and field test reports into the Operation and Maintenance manuals.

5.3 TESTING AND COMMISSIONING

- A. Contractor shall prepare and submit testing & commissioning procedure and check lists for MARAFIQ review and approval.
- B. Contractor shall perform commissioning tests of all components and related power & control interfaces to the switchgear required in the specification and witnessed by MARAFIQ representative.
- C. All materials shall be inspected by the contractor to check damages and general conditions of materials prior to fabrication and installation.
- Contractor shall perform tests on all control wiring terminations with UCS Marshalling breakers from UCS same as existing.
- E. Contractor shall be responsible to perform function test for all components and breakers control systems for the individual loops as well as total integrated system.
- F. Contractor shall include testing of Instrument Transformers, Protection Devices, and Grounding Resistance etc.

5.4 TRAINING

The Contractor shall provide O&M training on site for MARAFIQ engineers/ technic ans.

Attachments: Reference Drawings

1. One Line Diagram

Drawing No. 006Q-P-01-673

G.T. Generator & Substation

2. Metal Clad Switchgear

Drawing No. 311-2M05617

4.16kV cubicle & 600V MCS

3. Outline

Drawing No. 311-3K19631

480V Metal Clad Switchgear

4. Unified Control System

Drawing No. 00004-IN-A1-0884-B000 Plant Wide UCS





SECTION – IV M REPLACEMENT GENERATOR BREAKER OF GTG UNITS 1, 2, 3, 4, 7 & 8







I. TECHNICAL REQUIREMENTS

1. Introduction

Power & Water Utility Company for Jubail & Yanbu (MARAFIQ) is a Saudi Joint stock company established by Royal Decree to serve for the utilities requirement in the Industrial City of Jubail and Yanbu.

MARAFIQ is responsible for the operation and maintenance of existing facilities related with power and water utility systems and development, and expansion of these utility systems which comprise of power generation, transmission and distribution, sea water cooling supplies system, desalinated water (potable and process water) production and distribution, sanitary and industrial waste water collection and treatment.

2. Project Information

Presently there are eight (8) Hitachi make Gas Turbine Generator (GTG) units in the plant since 1981. The Electrical Generators are connected in tandem two (2) units each on one three winding step up transformer supplying power to 115 kV Substation. Each Generator is connected to 13.8 kV winding of step up transformer through Air Blast Circuit Breaker (ABCB).

The Air Blast Circuit Breakers are in operation for past 34 years. It is difficult to get spare parts as manufacturer Hitachi has stopped supporting ABCB. Hence it is decided to replace Six (6) numbers of ABCBs for GTG Units No. 1, 2,3,4,7 and 8.

Recently, two units Generator Breakers were replaced by SF6 Breakers.

3. Project Purpose

The objective of the project is to retrofit Six (6) existing GTG switchgears, associated disconnect switches, and other auxiliary equipment with 13.8 kV, SF6 circuit breakers and new Disconnect Switches along with associated auxiliaries.

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PROCUREME

4. Scope of Work

4.1 General

The scope of works under this contract shall include design & engineering, supply, installation, testing and commissioning of two each 15 kV, 4000A, 3P, 60 Hz, SF6 insulated Generator Circuit Breaker to be installed in new switchgear enclosures along with associated Disconnect switch, CTs, VTs and interfacing with existing systems. The existing switchgear enclosure (Hitachi make, Type ORB 10 D, Form 42 PADP) houses ABCB (Hitachi make, Type PBC-100, form PA JEC 145), Main Disconnect Switch (Hitachi make, Type TR3, form FFA) and associated auxiliaries. The scope of work shall include, but not limited, to the following:

- a. The Contractor shall supply and install following main equipment in new switchgear enclosures for each of the 6 nos. specified GTG Units, including all spare parts required for satisfactory operation of the equipment.
- b. Each of the Generator Circuit Breaker cubicles shall be equipped with the following:
 - i) Circuit Breaker, SF6 insulated, 15 kV, 4000A, 3P, 60 Hz. The CB shall have rated interrupting capacity of 1000 MVA at 13.8 kV and making capacity of 104.5 kA with short time rating of 41.8 kA. The opening and closing time of CB shall be 0.04 sec & 0.1 sec. respectively. The Basic Insulation level (BIL) of the CB shall be 110 kV peak and one minute power frequency withstand voltage shall be 50 kV. The Operating during CB shall be 0-1m-CO-3m-CO. Each CB shall be equipped with Operating Counter, SF6 gauge,



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- Mechanical Position Indicator to indicate Open &Close position, Manual operation devices for maintenance purposes and all other devices/accessories similar to existing CBs.
- ii) Disconnecting Switch, 15 kV, 4000A, 3P, 60 Hz. The Rated Short Circuit Capacity of Switch shall be 60 kA. The Operating Mechanism of Disconnect switch shall be complete with rod, indicators, operating handle and auxiliary switches.
- iii) CTs, VTs and all accessories and auxiliary equipment as may be deemed necessary. The VTS shall be draw out type complete with switch fuse unit.
- iv) All necessary modifications required on bus-duct terminations, if required for connecting GTG breaker cubicle in the system shall be carried out. The terminal connections to GTG breaker bus shall be by means of flexible bus bars.
- v) Two 3-phase earth switches shall also be installed in each breaker cubicle. (a) one earth switch for grounding the Generator incoming feeder (to be located on generator side of the breaker). (b) Another earth switch for grounding the outgoing feeder to Generator Transformer (to be located at the downstream side of the Disconnecting switch on the Generator Transformer side of the breaker). Each earth switch shall have two positions, Open and close. The switches shall remain in open position during normal operation when GTG breaker is closed. All the required permissive interlocks shall be provided to prevent operation of the earth switch on energized ('live' condition). Such interlocks shall include, but not limited to the following:
 - The earth switch on Generator side shall be able to be closed, only when Generator breaker is open, and also Generator side incoming conductors are de-energized ('dead' condition). Also the energization of the Generator shall be prevented, when the earth switch is in closed condition.
 - The earth switch on Generator Transformer side shall be able to be closed only when
 Generator breaker and corresponding disconnecting switch is in open position, and also the
 outgoing conductors on transformer side are de-energized ('dead' condition), by ensuring that
 CB on EHV side of the transformer is in open position. Also the energization of the transformer
 from the EHV side shall be prevented, when the earth switch is in closed condition.
- c. Following control & monitoring requirements shall be included.
 - SF6 gas density monitoring equipment shall be supplied and shall include an adjustable temperature compensated pressure switch.
 - ii) Circuit Breaker shall be equipped with two trip coils. External power supply for the control is 125 V DC. Control scheme shall be similar to the existing scheme with seamless interface with existing plant control. Upon loss of power supply, the breaker shall remain either in fully open or fully closed position.
 - iii) The Contractor shall re-connect the existing cables for control & interface with existing system to the extent possible. In case existing cables fall short or is found in damaged condition, then the Contractor shall replace such cables with new ones. No splicing in control cable shall be permitted.
- d. All electrical, civil, foundation and structural works required for installation and commissioning of CBs,
 Disconnecting Switches, CTs and VTs in new enclosure. This also includes inspection, testing, commissioning and energization of the CB and associated equipments.
- e. Quality Assurance and Quality Control for both materials and workmanship.
- f. Verification of all specified sizes and quantities for system and components.

g. Engineering and design works including preparation of specification, design and shop drawings, calculations studies etc. required for satisfactory completion of the job.

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- h. Preparation of installation data and drawings.
- i. Testing and certification of specification compliance for all product and test
- Delivery of all materials and equipments to the site including unloading, storage and in all ation in the respective places.
- k. Special tools required for the initial installation and future maintenance.
- I. Implementation of all manufacturers' standards, quality control, inspection and testing procedures.
- m. Preparation of As-Built drawings including revision of existing interface drawings (originals) to as built condition.
- n. The Contractor shall arrange for the training of MARAFIQ personnel. This shall cover operation, maintenance and trouble shooting. The material and duration of the training shall be as per manufacturer's recommendation.
- Disconnection, removal and clean-up of the existing old ABCB, ABCB cubicle, ABB make Air Compressor Cubicle, Main Air Reservoir for ABCB along with associated piping and instrumentation and related equipment to prepare for the installation of new equipment.
- p. Recommended Spares for two (2) years of trouble free operation.
- q. The scope of supply shall also include all commissioning equipment/ spare parts and operational spares or items for two years.
- r. The Contractor shall provide a Recommended Spare Parts List (RSPL) for 15 years operation with complete procurement information. The manufacturer shall confirm that the offered spares will not be obsolete for about fifteen years of operation from the date of commissioning.
- Transporting all the removed equipment to MARAFIQ-designated warehouse.

4.2 Detailed Scope of Work

The Gas Turbine Generator (GTG) CBs are very critical to power generation system. The GTG CB connects the generator to step up transformer for power transmission. If any one of the GTG CBs fails, then corresponding Generator will be isolated resulting in loss of power and severe impact on Generation system. Hence it is decided to replace ABCBs with SF6 insulated CB for increased reliability.

The Contractor shall carry out the work on turnkey basis including engineering, manufacturing of the equipment, field installation in existing MV switchgear, interface of the new equipment with existing plant equipment, testing and final commissioning.

For successful completion of retrofitting of existing GTG ABCB with SF6 gas insulated CB, the Contractor shall conduct site survey and gather all information related to existing ABCB.

The Contractor is responsible for complete engineering and design activities including calculations, studies, drawings, inspection & test plans, and other submittal requirements specified elsewhere in this contract. The Contractor shall, as a part of his responsibility, check the ratings and sizes of those components whose rating and sizes are specified in the contract document,

The Contractor's scope of work shall include following as a minimum but not limited to;





- a. Preparation of design drawings for new CB cubicles with SF6 CBs. The Contractor shall prepare control schematics and other related drawings for the new equipments to be installed. The protection, control and monitoring scheme shall follow the existing philosophy. The Contractor shall update the existing drawings for other plant systems interfacing with the new installation.
- b. Removal of existing cubicles with circuit breakers & equipment from Six (6) GTG ABCB No. 1, 2,3,4,7 and 8 as listed in drawing no.311-2M06182.Each enclosure houses mainly the following equipment.
 - Draw out type 15 kV, 4000A, 3P, 60 Hz ABCB along with other equipment as listed in Drawing No.311-2R01212.

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- II. Disconnecting Switch along with operating device.
- III. Potential Transformer (VT) along with switch fuse unit in draw out carriage
- IV. Bushings & Bushing CTs.
- V. Exhaust Chambers, Exhaust Pipes etc.
- c. Removal of entire ABCB Compressor Cubicle as shown on Drawing No. 311-3M20681 along with related copper piping, isolating valves and various pressure gauges, pressure Indicators etc. The Contractor shall verify that the ABCB Compressor Cubicles and Main Air Receivers are dedicated for GTG ABCB only and their removal does not affect any other services.
- d. Removal of power and control cables from GTG MCC to Air Compressors in Compressor cubicle. Removal of all instrument, control and indication wirings.
- e. Removal of Main Air Reservoir as shown on Drawing No. 311-3R02196 along with pressure gauges, safety valves, drain valves and all piping.
- f. Installation of new CB Cubicle housing SF6 insulated, 15 kV, 4000A, 3P, 60 Hz Circuit Breakers complete with all associated accessories and interlocks as specified in but not limited to Drawing No. 006R-P75-006 for satisfactory operation of the CB and all associated equipment. The Contractor shall also provide additional interlocks as required for the control scheme. The new CBs shall be interfaced / integrated with existing system for all controls, protection as well as indications and alarms associated with Unified Control System (UCS) in Central Control Building No, 13.
- g. Installation of new 15 kV, 4000A, 3P, 60 Hz disconnect switches and earth switches, complete with operating mechanism and all associated accessories required for satisfactory operation of disconnect switch. The new disconnect switch and earth switches shall be interfaced / integrated with existing system for all controls, indications and alarms associated with UCS in Central Control Building No, 13.
- h. Supply and install new CTs and VTs required for indication, control and protection.
- Connection of CB and Disconnect switch to incomer and outgoing bus bars respectively.
- j. The work also includes necessary controls, connections and interface with existing plant equipment, testing and commissioning.
- k. Testing of the Protection Relays. The operating characteristics of the replaced new equipment (CB, CT, VT etc) may have an impact on the protective relay system settings and balancing. In any case, the protective relaying system shall be tested during commissioning of the new system.

The basic settings may use the existing settings as a guide except where affected by the new equipment characteristics. However, since the circuit breaker, CTs and VTs are replaced under this project; the Could be considered.

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shall evaluate effects of such changes and any modification if required in the settings. The revised relay coordination studies with relay settings, Time Current Coordination (TCC) curves, and other applicable calculations, selection/design criteria etc. shall be submitted for MARAFIQ review and approval. The Contractor shall submit the protective relay test plan for MARAFIQ approval before executing the work.

- Connecting the control and monitoring signals to the plant UCS system and re-configuring the system to delete
 any signals that are no more used and to include new signals such as SF6 gas pressure.
- m. Loading, transporting and unloading of all removed equipment to the MARAFIQ designated area.
- n. Assessing the condition and life expectancy of removed ABCB and associated equipment along with recommendation from manufacturer for using the removed ABCB and its components as spare parts for remaining GTG ABCBs.
- The Contractor shall replace existing GTG breaker with new Generator Breaker Generator with grounding facility for GTGs 1,2,3,4, 7 & 8.
- p. The Contractor shall configure the Generator Breaker permissive signal with new isolator and grounding facility for preventing inadvertent mal operation in existing system. If required contractor shall modify the configuration and logics in existing system.
- q. Generator Breaker PT shall be protected with fuse and isolator. Fuse shall have provision of removal in service without shutting down the transformer.

5. Existing Equipment Data

5.1 Generator Circuit Breaker Name Plate Data

The following are the main characteristics of existing Hitachi make GTG ABCB

a.	Type of ABCB	PBC-100
b.	Form of ABCB	PA JEC 145
c.	Rated Voltage	15 kV
d.	Rated Current	4000 A

e.	Rated Interrupting Capacity	1000 MVA at 13.8 kV

f.	Making Capacity	104.5 kA
В	Short Time Capacity	41.8 kA
h.	Opening Time	0.04 Sec.
i,	Closing Time	0.1 Sec.
i.	Interrupting Time	5 Cycle.

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k.	Basic Insulation Level (BIL)	110 kV (Peak)

I.	Power Frequency Withstand Voltage	50 kV for 1 minute.

m.	Air Reservoir Capacity	300 L
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n.	Operating Duty	O-1m-CO-3m CO







p. Weight 1300 kg.
 q. Manufacturer's No. 413360-1

r. Date of Manufacturing 1981.

5.2 Main Disconnect Switch (DS) Data

The operating mechanism of disconnect switch comprises of operating handle, rod, indicator, and auxiliary switches. The following are main characteristic of Hitachi make Disconnect Switch.

a. Type of DS TR3

b. Form of DS FFA

c. Rated Voltage 13.8 kV

d. Rated Current 4000 A

e. Rated Short Circuit Current 60 kA

5.3 Switch Gear Cubicle Data

The following is cubicle nameplate data. The cubicle is Hitachi make and houses GTG ABCB and disconnect switch.

a. Type of cubicleb. Form of cubicle42 PADP

c. Cubicle suitable for 13.8 kV, 4000 A.

d. Short Circuit Current 42 kA for 1 Sec.

e. IEC Standard IEC-60298

f. Manufacturer's Number 112733-1

g. Date of Manufacturing 1981

5.4 GTG Generator Data Connected to ABCB

The generator is high resistance grounded through grounding transformer. The following is the Generator data connected to step up transformer through GTG ABCB. For additional data, please refer to generator Data Sheet enclosed herewith.

a. Rated Power (ISO) at 15° C 93,300 KVA

b. Unit Peak Output at 50° C (Site Cond.) 77,125 KVA (App.)

c. Speed of Generator 3600 rpm

d. Normal Frequency 60 Hz.

e. Rated Voltage 13.8 kV

f. Voltage Operating Range +/- 5 % of the rated voltage





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g. Generator Reactance Value (pu) at rated voltage (Saturated)

l.	Synchronous Direct Axis Reactance Xd	1.9
II.	Transient Direct Axis Reactance X'd	0.25
III.	Subtransient Direct axis Reactance X"d	0.157
IV.	Negative Sequence Reactance X2	0.157
٧.	Zero Sequence Reactance X0	0.09

h. Time constants

1. Transient Open Circuit Tdo'	7.6 Sec.
II. Transient Short Circuit Td'	0.88 Sec.
III. Sub-transient Open Circuit Tdo"	0.05106 Sec.
IV. Sub-transient Short Circuit Td"	0.04 Sec.

3.5 Generator Transformer Name plate Data

The generator voltage is stepped up by a 3 winding Generator Step-up Transformer connected in tandem to GTG ABCBs. The transformer is built according to ANSI C57.012. The following is transformer data.

a.	Rated Power at 55° C	175 MVA/87.5MVA/87.5 MVA

b. Rated Current

l.	HV Side	878 A
II.	LV1 Side	3856 A
III.	LV2 Side	3856 A

c. Rated Voltage

١.	HV Side	115 kV +/- 2X2.5%
II.	LV1 Side	13.1 kV
III.	LV2 Side	13.1 kV

d. Connection Y Grounded/Delta/Delta

e. Short Circuit Reactance at rated voltage and 175 KVA base.

ı.	Z(HV – LV1)	22%
II.	Z(HV – LV2)	22%
III.	Z(LV1 – LV2)	40%







6. MATERIAL SPECIFICATIONS

6.1 APPLICABLE CODES AND STANDARDS

Except as otherwise stated herein, all equipment furnished in accordance with this Specification shall comply with latest applicable codes and standards. As a minimum, the following individual codes and standards shall apply.

IEC	International Electro-Technical Commission		
IEC60Q44-1	Instrument transformer – Part 1: Curent transforme		

IEC 60044-2 Instrument transformer – Part 2: Voltage transformers
IEC 60056 High Voltage Alternating Current Circuit Breakers.

IEC 60694 Common Clauses for High Voltage Switchgear and Control gear Standards

IEC 62271-200 High-Voltage Switchgear and Control gear Part 200: AC Metal-enclosed Switchgear and

Control gear for rated Voltages above 1 kV and up to and Including 52 kV

IEC 62271-102 High-voltage switchgear and control gear - Part 102: Alternating current disconnections

and earthling switches

IEC 60376 Specification of Technical Grade Sulfur Hexafluoride (SF6) for Use in Electrical

Equipment

IEC61166 High-Voltage Alternating Current Circuit-Breakers - Guide for Seismic Qualification of

High-Voltage Alternating Current Circuit-Breakers.

IEEE Institute of Electrical and Electronic Engineers

IEEE C37.013 Standard for High AC High Voltage Generator Breaker

Rated on Symmetrical Current.

IEEE C37.013a Standard for AC High Voltage Generator Circuit Breakers

Rated on a Symmetrical Current Basis -Amendment 1: Supplement for use with Generators Rated 10-100 MVA

NFPA National Fire Protection Association

NFPA 70 National Electrical Codes (NEC)

Royal Commission for Jubail and Yanbu:

General Design Criteria and Technical Guidelines.

6.2 NEW GENERATOR CIRCUIT BREAKER

The new Circuit Breaker shall be SF6 Circuit Breaker compatible with existing breaker and shall be standard product of manufacturer and shall exceed all basic characteristic and option of existing breaker. It shall be capable of performing required duty and interface with controls and monitoring of existing plant equipment. Additional features as recommended by manufacturer shall be incorporated in the system.

The manufacturer shall be reputed company in this field with long experience in manufacturing of SF6 Generator Circuit Breakers, and other electrical equipment. It shall have permanent representation in KSA and shall support the product with technical assistance and spare parts for at least 20 years. The preferred manufacturer shall be ABB, Hitachi, DE, AREVA or Siemens.



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The new CB with SF6 gas as insulating and interrupting medium shall incorporate following features:

- The 3 Pole circuit breaker complete with operating mechanism, supervisory and control elements shall be assembled on common frame.
- b. The phase distance between poles of CB shall match with phase distance between connected bus bar to generator and step up transformer.
- c. The circuit breaker shall be self-cooled and use self-blast principle for interruption of arc. The arc voltage of circuit breaker shall be high enough to ensure current zeros in case of generator source short circuit currents with delayed current zeros. The breaker shall have two separate contact system. One for carrying load current and other for arc interruption.
- d. Completely assembled circuit breaker including driving linkages and other operating parts, shall have required mechanical strength to withstand all stresses resulting from rated short circuit current.
- e. The time between first and last pole to open or close shall not exceed 36 electrical degrees (2ms), The circuit breaker shall be electrical trip- free to prevent pumping.
- f. The Contractor shall supply required SF-6 gas cylinders.
- g. All necessary SF6 gas filling devices including associated accessories and special tools for filling the SF6 gas shall be supplied by the Contractor.

6.3 OPERATING MECHANISM

- a. The circuit breaker shall be actuated by a spring operating mechanism.
- b. The control voltage available for operation of circuit breaker is 125V DC.
- c. The operating mechanism shall operate all three poles of circuit breakers simultaneously through appropriate mechanical linkages.

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- d. The stored energy of operating mechanism shall be sufficient to perform 2 complete close open operations.
- e. The operating mechanism shall ensure positive opening of the circuit breaker irrespective of tripping impulse is received in partially closed or fully open position of the circuit breaker.
- f. The circuit breaker shall be provided with suitable means for local operation of the CB for inspection and adjustment purposes.
- g. An operating lever shall be supplied for manual operation (opening and closing of CB) under no-load condition.

6.4 SF6 GAS MONITOR

- a. The CB shall be equipped with SF6 gas density monitor to monitor the density of SF6 gas in all three breaker poles. The monitor shall be provided with temperature compensated pressure switch and shall be adjustable.
- b. One of the contacts of pressure switch shall be used to raise the alarm for refilling of SF6 gas in case of fall of gas density below acceptable level.





c. When the density drops below the specified level, the density monitor shall signal loss of SF6 gas in several steps. (Warning, alarm and blocking).

6.5 CIRCUIT BREAKER CONTROL

- a. Circuit breaker shall be provided with two trip coils suitable for operation at 125 V DC.
- b. The Control Scheme shall be similar to existing one complete with interface with existing plant control.
- The CB shall remain in fully open or closed position on loss of driving energy or failure of control power supply.

6.6 ACCESSORIES

The CB shall be provided with, but not limited to the following accessories.

- a. An operation counter
- b. SF6 pressure gauge
- c. SF6 gas monitor unit
- d. Reliable mechanical position indicator to display open and close position of the circuit breaker
- e. A manual Operation device for maintenance purpose
- f. All other accessories required for satisfactory operation of the CB

6.7 INSULATION

The CB shall withstand three times the phase to ground voltage with CB contact open and insulating gas pressure equal to that of atmosphere. This is to ensure that the CB is capable of withstanding voltage when two systems are out of phase.

All parts of insulating structure, including those between phases to earth and across the open contacts, shall be of inherently stable nature with a minimum susceptibility to dielectric tracking.

6.8 CONTROL EQUIPMENT

The Control Cubicle shall accommodate all necessary equipment for local/remote changeover facilities, control monitoring, supervision and interlocking system using conventional hard wire control and supervisory equipment. The number of Normally Open (NO)/ Normally Closed (NC) contacts shall be similar to existing one as shown on Dwg. No. 311-3-3R02205. In addition to this the Contractor shall provide at least 2NO & 2NC spare auxiliary contacts. All spare auxiliary contacts shall be wired to terminal blocks. All terminals and control wires shall be permanently tagged in proper manner for identification.

6.9 LIVE CONNECTORS

All live connectors shall be of same material as existing one. All bus joints shall have silver to silver contact surfaces. Insulating support shall meet the dielectric strength specified and shall be capable of withstanding the mechanical forces imposed on it during opening operation of CB under fault condition.



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6.10 NAME PLATE

A proper nameplate shall be attached to the equipment similar to existing equipment. It shall be placed in such a position so that it shall be clearly visible and readable. The nameplate shall contain all required information including characteristic, Serial Number, Year of manufacture, etc. as per applicable international standards and existing equipments.

6.11 NEW DISCONNECT SWITCH

The disconnect switch shall be from same manufacturer as Generator Circuit Breaker or other approved manufacturer similar to existing equipment. Electrical characteristic shall be same as that decisions

7.1 EXECUTION

7.1.1 WORK, PLANNING & SCHEDULING

- a. The Contractor shall prepare a schedule for removal of old equipment and installation or new equipment. The schedule shall be submitted to MARAFIQ for their review and approval prior to commencement of the work.
- b. The schedule shall be prepared in such a way as to ensure that there would not be any unwarranted power outage to any other facility while executing the work. The plan shall be prepared to ensure minimum shutdown period for replacement of two (2) GTG ABCB in tandem.
- c. The plan shall be in narrative form describing the work sequence, shutdown period, method of implementing removal of old units, installation of new equipment, testing and commissioning activities with minimum shutdown time. The work plan/procedure shall be submitted for MARAFIQ approval before scheduling the shutdown for execution of the job.

7.1.2 REMOVAL OF EXISTING EQUIPMENT

- a. The Contractor shall remove all equipment described under detailed scope of work very carefully. This shall include old GTG ABCB along with ABCB Enclosure, disconnect switch from existing cubicle, removal of all other auxiliaries such as compressor, compressor cubicle, power supplies to compressors and air receiver.
- b. The removal of existing equipment shall not cause any unwarranted disruption of other services.
- After removing compressor cubicle and air receiver, their flooring place shall be repaired to match with existing flooring for required use.
- d. Old existing equipment shall be removed very carefully so that no damage occurs during removal and handling. The Contractor shall arrange for assessment of condition and life expectancy of removed ABCB and associated equipment by circuit breaker manufacturer. The life expectancy and condition assessment together with manufacturer's recommendation shall be provided to MARAFIQ for using the removed ABCB and its components as spares for remaining GTG ABCBs.

All removed equipment shall be transported and unloaded at MARAFIQ designated area for using them as spares for remaining GTGs.

7.1.3 INSTALLATION OF NEW EQUIPMENT

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- a. The Contractor shall install new Cubicle for SF6 Circuit breaker along with disconnect switch & earth switches in new cubicle as per approved design and shop drawings. The work shall be performed by skilled & qualified field personnel in accordance with good electrical engineering practice.
- b. All equipment moved to site shall be inspected for damage or deterioration during storage prior to installation.
- c. Installation of new equipment shall be in accordance with applicable IEEE/IEC standards and approved project/manufacturer's drawings.
- d. The Contractor shall be responsible for installation and reconnection to existing power buses and all control and monitoring devices into existing GTG unit control system. All new equipment shall be connected to existing equipment ground.
- e. Any modification required in plant, existing switchgear cubicle, or existing foundation for installation of new equipment shall be the responsibility of the Contractor.
- f. The Contractor shall be responsible for the completeness of the erected equipment and shall test and verify the operation of all components, assemblies, sub-assemblies, controls and auxiliary devices. The new installation shall be properly interfaced /integrated with existing system.
- g. Procedure for tightening electrical connectors and terminals including torque tightening values shall be in accordance with manufacturer's recommendations.
- Installation work including testing shall be supervised by manufacturer's representative.
- i. All equipment shall be installed in workman-like manner to the satisfaction of the MARAFIQ representative.

7.2 INSPECTION AND TESTING

7.2.1 FACTORY TESTS

a. General:

- Perform complete factory tests on Circuit Breakers, Disconnect Switches, CTs and PTs prior to shipment
 to demonstrate to MARAFIQ that the equipment meets the requirements of this Specification. Prior to
 start of manufacturing, the Contractor shall submit for MARAFIQ approval a complete listing of all Routine
 Tests to be performed and Type Tests to be either performed or certified. The listing should clearly specify
 the test criteria and the methods of testing and sampling. The equipments shall not be shipped unless
 results of tests show compliance with all requirements of this Specification.
- 2. Factory tests prescribed by this specification are to be made at the expense of the Contractor. All samples shall be furnished by the Contractor.
- In the event of failure of any equipment to meet the test requirements, the Contractor shall replace the defective items at his expense.
- 4. MARAFIQ reserves the right to witness all tests. Contractor shall provide written notification to MARAFIQ at least four (4) weeks in advance of test date. The Contractor shall submit to MARAFIQ, the test procedures including brief description, connection diagram, proposed test sheets results and minimum & maximum values of specified tests which will be used to determine conformance with the specification and applicable standards. The switchgear manufacturer shall not proceed with the tests until MARAFIQ representative arrives or until he has received written notification that MARAFIQ has elected to waive witnessing a particular test.

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All expenses including the travelling, accommodation and transportation of two (2) MARAFIQ representatives to witness the factory tests shall be borne by the Contractor. The Contractor shall make all necessary arrangements for witnessing the factory tests by MARAFIQ representative.

- The Contractor shall maintain a file of all test reports which shall be fully auditable and accessible to MARAFIQ.
- Manufacturer's tests, as well as all tests required by the applicable standards, shall be performed. Tests listed below are representative only and do not constitute all the required tests.

b. Type Tests:

Type tests shall be performed in accordance with applicable standards for the switchgear. MARAFIQ shall waive the Type Tests, provided the Contractor/manufacturer has performed these tests on identical equipment as that supplied under this contract. The certified test reports shall be submitted in lieu of performing the type tests.

c. Routine Tests:

Routine tests shall be performed on equipment in accordance with applicable standards.

d. Test Report

The Contractor shall submit certified reports of all Routine and Type tests performed for approval prior to shipment of the equipment.

7.2.2 FIELD TESTS

The Contractor shall perform field tests on all equipments installed under this contract.

- a. The Contractor shall develop a detailed Inspection and Test Plan based on the project requirements in accordance with applicable standards and manufacturer's recommendations indicating all hold points and MARAFIQ witnessing stages. The Inspection and Test Plan shall be submitted for MARAFIQ review and approval.
- All field tests including functional checks shall be performed to ensure that the equipment installed comply with operational requirements.
- c. Test procedures shall include descriptions of test equipment, connection diagrams, test sheets, calculations, and minimum/maximum test and performance values to be used in determining the acceptability of the installed equipment.
- d. The Contractor shall give at least three days (72 hours) advance notice to MARAFIQ to conduct inspections and to witness specified test. MARAFIQ shall confirm exact day and time of such inspection or test.
- MARAFIQ shall have the right to reject any part of the work found to be unsatisfactory or not in conformity with the approved standard, such rejected work shall be satisfactorily corrected, revised or replaced at the Contractor's expense.

7.3 SUBMITTALS

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- a. At least three (3) weeks prior to scheduled tests, the Contractor shall submit to MARAFIQ, the test procedures including brief description, connection diagram, proposed test sheets results and minimum & maximum values of specified tests.
- b. Test Reports: The Contractor shall submit four (4) hard copies and one soft copy of manufacturer's test certificates, reports of all tests conducted at factory and field including routine, type and functional checks. All test reports/certificates shall be duly attested by authorized person and shall include the date of the test and name of the person in charge of the test.
- c. The Contractor shall prepare and submit four (4) hard copies and one soft copy of operation and maintenance manuals after installing and testing all equipment under this contract. The manuals shall be complete with all equipment characteristics, factory information, drawings, test certificates, troubleshooting and maintenance procedures, calibration procedures.
- d. The Contractor shall submit all 'as built' new and modified existing drawings. The Contractor shall also include them in operation and maintenance manuals.
- e. The Contractor shall submit material list, design & shop drawings, manufacturer's product data and catalogues for all equipment supplied along with installation details.
- a. The Contractor shall submit list of spare parts required for satisfactory operation of the equipment.

7.4 REFERENCE DRAWINGS/DOCUMETS

Please find enclosed herewith following reference drawings/documents for this project. The Contractor shall retrieve other related drawings/documents from MARAFIQ Library/Document Control Section after award of contract.

Sr. No.	Drawing Title	Drawing No.
1	One Line Diagram of G.T. Generator	006Q-P01-673
2	Outline of 13.8 kV ABB Cubicle	311-2M06182
3	Outline Drawing of 13.8kV, 1000MVA, 4000A, Air Blast Circuit Breaker	311-2R01212
4	Installation of 13.8 kV ABB Cubicle	311-2M05613
5	Disconnecting Switch	311-2P01130
6	Interlock Diagram for Generator Breaker (52G)	006R-P75-006
7	Wiring Diagram for Air Blast Circuit Breaker	311-3R02205
8	ABB (52G) Circuit Elementary Diagram, Sh. No. G03A	331DF26083
9	ABB (52G) Circuit Elementary Diagram, Sh. No. G03B	331DF26083
10	ABB (52G) Circuit Elementary Diagram, Sh. No. G03C	331DF26083



11	Outline of ABB Compressor Cubicle	311-3M20681
12	Air Piping System	Fig. 1
13	Main Air Receiver for Air Blast Circuit Breaker	311-3R02196
14	One Line Diagram of Unit 480V, 120/208 V & 125 V DC	006Q - P01 - 674
15	Arrangement of Motor Control Center	331 Qf 29461
16	Arrangement of Cable Route	0-0016
17	Name Plate of Generator	IOR 189 - 303
18	Generator Technical Data Sheets	1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -

7.5 BILL OF MATERIAL

This Section of the Scope of Work is given for reference only. The Contractor shall verify and determine all the materials and supplies needed for this Project. Any supplies or materials not mentioned in this section, but needed to complete the Project, are deemed to be part of Contractor's supply.

Sr. No.	ITEM DESCRIPTION	UNIT	QUANTITY
1	Removal of ABCB Enclosure along with 13.8 kV GTG ABCB, Disconnect switch and associated auxiliaries as described in Scope of Work (SOW)	SET	6
2	Removal of Compressor Cubicles including compressors, piping, pressure gauges, power supply cables from GTG MCC for compressors & associated auxiliaries, and repairing of floor as described in SOW	SET	6
3	Removal of Main Air receiver along with associated piping, pressure gauges & auxiliaries and repairing of floor as described in SOW.	SET	6
4	Loading, Transporting and Unloading of removed equipment at MARAFIQ designated Area.	LS	LS
5	Supply, Installation and termination of 15 kV, 4000A, SF6 Generator Circuit Breaker along with Earth Switches, Disconnect Switch and associated auxiliaries including controls & protection, grounding of all installed equipment interfacing with existing system as described in SOW.	EA	6
6	Complete design / engineering and supply of design & shop drawings and documents, test reports, As-Built drawings and documents, operation & maintenance	LS	6
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manuals etc. after installing and testing all equipment as described in SOW

- 7 Supply of all spare parts for satisfactory operation of LS LS installed system as described in SOW
- 8 Training of MARAFIQ Personnel as described in SOW LS LS
- 9 Testing and commissioning of Complete system as per LS LS Scope of Work including witnessing of Factory Test by MARAFIQ personnel

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- Assessing the condition and life expectancy of removed ABCB and associated equipment along with recommendation from manufacturer for using the removed ABCB and its components as spare for remaining GTG ABCBs.
- 11 Total





SECTION – IV N REPLACEMENT OF HYDROGEN CONTROL PANEL FOR GTG UNITS 3-8







I. TECHNICAL REQUIREMENTS

1. Project Purpose

The purpose of the project is to provide two Hydrogen Control and Gas Purging Control Panels in GTG units 3-8 on a turnkey contract to provide a reliable and accurate measurement of Hydrogen pressure, Hydrogen purity (% Hydrogen in Air), and purge gas measurement (% H2 in CO₂ and % Air in CO₂) in the generator housing to ensure safe and efficient operation.

The new Hydrogen Control Panel and the Purging Control Panel shall be state-of-the art preferably OEM supplied hydrogen control / monitoring system to replace fully the existing Hitachi Hydrogen Control and Purging Control panels. Alternatively panels equipped with Yokogawa analyzers or Teledyne analyzers shall be acceptable provided they meet the requirements as per philosophy of existing system. The new panels as a minimum shall provide all the existing local / remote control and monitoring functions.

The signals transmission interface with local facilities and MARAFIQ Central Control Room (CCR) in Central Control Building (CCB) for monitoring will remain the same as existing except as described in interface.

2. Project Overview

MARAFIQ has set up a power generation facility in the form of nine GTG and four STG. The existing Hydrogen system in GTG area was supplied / commissioned by Hitachi, the OEM. The Hydrogen Control Panel houses purity meters, purity meter transmitter and its flow meter, machine gas pressure gauge, machine gas temperature gauge, machine gas pressure switch, fan pressure gauge and collective trouble indicator etc. Out of three purity meters, one is for machine gas purity measurement while the other two are for scavenging gas purity measurement. The collective trouble alarm also activates buzzer and the Loss of DC power source is annunciated by a bell. All above meters facilitate in maintaining gas purity, gas pressure and gas temperature and their supervision.

The Purging Control Panel measures the discharge gas purity which is taken out of the outdoor air discharge pipe for the purpose of purity measurement at the time of purging. The gas purging control panel is wall mount type and is provided with a purity meter having double readings, one of which indicates $0 \approx 100 \%$ of air purity in the CO_2 and the other indicates $0 \approx 100 \%$ of hydrogen purity contained in the CO_2 .

The original equipment is already out of production & an alternate is also not available as confirmed by NEPCO, the National Electric & Products Co. The H2 purity meter is also out of production. The Hitachi recommends replacing both the H2 control Panel and the Gas purging control Panel.

The work involves engineering, design, fabrication, procurement, delivery, erection, supervision; start up, testing and commissioning of systems for hydrogen panels in MARAFIQ Power and Water Plants premises.

3. Project Location

The proposed project shall be located inside the plants of MARAFIQ for Power Generation and Water Production & Pumping facilities complex. These plants are located in Main Industrial Area of Madinat Yanbu Al-Sinaiyah phase 1.

4. Reference Documents

Annexure in section 5 are given for reference to show the existing system, the location and arrangement of the existing equipment and proposed location of new equipment.





5. Deliverables

1. PRELIMINARY EQUIPMENT LIST (PEL)

The PEL for all new equipment, material including all the field and control instrumentation items and special tools if any associated with the execution of this project shall be prepared by the contractor and submitted to MARAFIQ for review and approval. The PEL shall contain the following information as a minimum.

- 1. Areas and System
- 2. Equipment Name
- 3. Equipment Description
- Quantity to be installed

2. RECOMMENDED SPARE PARTS LIST (RSPL)

Recommended Spare Parts List for 2 years of normal operation of the system and equipment installed shall be prepared by the contractor and submitted for MARAFIQ review and approval during final commissioning phase of the project. The RSPL sample form will be given to contractor upon request.

The supplier shall confirm that the flow meter and all its accessories will be supported for spare parts without becoming obsolete, at least for Twenty (20) years after the placement of order.

3. RECOMMENDED SPARE PARTS

Recommended Operational Spare Parts for two (2) years subjected to MARAFIQ APPROVAL.

4. EQUIPMENT TAGS

- a) Tags shall be fabricated, provided and installed by the Contractor using stainless steel sheet of approximately 76(L) x 25(W) x 1.5(T) mm dimension. The tags shall contain an alpha-numerical number (in both English and Arabic) engraved on the sheet metal and shall remain eligible in the environment they will be installed. The sequence and numbering for Tags shall be based on the existing tag numbering system.
- b) The Tags shall be attached to the equipment in a conspicuous place, where it will not interfere with the operation of the equipment, using a method to securely attach it to the equipment that is compatible with equipment design. A Sample of Tags shall be submitted to MARAFIQ for approval prior to the installation.

5. OPERATION & MAINTENANCE MANUAL

- a) Two sets of Basic O & M manual shall be provided for preliminary review and approval prior to printing the final manual. Upon MARAFIQ approval 5 sets of basic O & M manual and vendor manual shall be provided as a close out requirement.
- b) The illustration and typography of the manual shall be modern, legible and not less than 10 point fonts. The O & M manual shall be printed on loose leaf paper and bonded in hard binder using corrosion resistance post and screw fasteners. The entire manual shall be submitted prior to the final commissioning of the project.
- The manuals shall also have "Preventive Maintenance routine Task sheets with recommended frequency".

6. AS-BUILT DRAWINGS

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Contractor shall prepare on Micro station and submit the final As-Built Drawings for the installed system. Contractor shall provide one (1) set of Original Drawings, three (3) sets of copies to MARAFIQ at the time of Initial Acceptance. All the drawings shall be prepared in accordance with the MARAFIQ Drafting Standard. Drawings shall be as per agreed list with file name and path.

6. Drawing & Documents

A. Drawings & Documents

The drawings and documents shall include submittals of Design Drawings, shop drawings, as-built drawings and other misc. documents:

i. Civil, Mechanical & Process:

- a. Process, flow & instrumentation diagram
- b. General Layout
- c. Foundation / Base Details
- d. Fabrication, and Details of Assembly
- e. Structural Steel Member Computations
- f. NFPA Calculation as per latest standard

ii. Electrical, Instruments & Controls

- a. Equipment & Cable Layout
- b. Cable Termination details
- c. Instruments inter-wiring diagram
- d. Elementary diagrams, schematics, interconnection diagrams
- e. Logic, SAMA & Configuration diagrams
- f. Instrument loop diagrams and equipment data sheet
- f. Instruments mounting details
- g. Cabinet layout drawing showing internal components
- h. Installation and interface details; Vendor's drawings.
- As-Built drawings reflecting all changes based on construction variations.

B. Equipment Specification submission

Calculations: Submittal of calculations shall include the following as a minimum:

- Possible Hydrogen percentages and reflection in display
- C. Material Specification and Data Sheets

Submit manufacturer's catalogue technical and descriptive data for all equipment, prior to procurement.









7. Scope of Work

The work of this Contract includes all engineering, design, procurement, manufacturing, construction, interfacing with existing systems, testing, commissioning, start up and training to MARAFIQ personnel for the replacement of two Hydrogen Control and Gas Purging Control Panels in GTG units 3 -8 on a turnkey contract basis as following;

1- HYDROGEN CONTROL CABINET

Here in briefly functionality is described that is to be replaced;

On the hydrogen control cabinet are fitted purity meter, purity meter transmitter and its flow meter, pressure gauge in the machine, machine gas temperature gauge, machine gas pressure switch, fan pressure gauge and collective trouble indicator.

Three purity meters are provided one for measurement of gas purity in the machine and two for measurement of scavenging as purity.

There is pressure gauge for the machine gas pressure with the scale range of 0 to 3 .0 kg/Cm²g.

The pressure alarm switches in the machine for pressure rise alarm use and pressure down alarm use are provided. The collective trouble indicator not only depicts troubles but gives alarm by a buzzer. Even if the buzzer is stopped by pushing reset push button, the indicating lamp is lit until, the trouble is corrected and at the same correction of the trouble the indicating lamp is put off.

Loss of D .C. electricity source is shown by a. bell. Simultaneously all the troubles are shown on the trouble indicator provided at the central control room as "troubles in hydrogen system".

All the above meters have function to facilitate to maintain safely the gas purity, gas pressure and gas temperature and to supervise then.

Gas flow meter is attached on the hydrogen gas supervisory panel and used either for measuring the flow rate in a gas purity meter or for the amount of the

Scavenged gas from the scavenging pipe taken out of the seal drain sump.

The flow meter is calibrated for an atmospheric pressure, for a room temperature

of 200C and for a hydrogen gas purity of 100 %. Measurable Hydrogen gas flow rate is from 400 to 3000 cc / min. Compensation coefficient K due to the changes of the hydrogen gas purity is applied from the compensation coefficient curve.

Oil and water leak alarm relay is used for detecting oil or water leak in the generator. Contacts of the mercury switch in this relay are opened or closed at activation to give alarm in the supervisory panel.

Gas temperature indicator (machine gas temperature gauge) is attached on the hydrogen control panel to detect the hydrogen gas temperature sealed in the generator and composed of an indicator proper, a power source box with a compensating rheostat and an embedded temperature detector.

Temperature relays are automatic switches which operate within a desired temperature range whenever there is a rise or drop in temperature. Their mercury switches can be mounted either on the left or on the right; by reversing the mounting position, it is possible to make the switch operate in the opposite manner. These instruments are used as temperature relays for the gas temperature inside the gas dryer and inside the generator.

SETTING OF ALARM

1. Alarm will be given by buzzer using dc, source of 125V. The alarm indicates

the troubles by the collective defects indicator. At the same time "defects in Hydrogen system" is shown in the defects indicator which is provided in the Central Control Room. Thus alarm is given.

Kinds of alarm and respective set value are given as follows:

- (1) Loss of A.C. source
- (2) Loss of D .C source
- (3) Hydrogen purity drop (MY-321) it is set at 85%
- (4) Pressure rise of the machine (PS-321) it is set at 2.5 kg/cm2
- (5) Pressure drop in the machine (PS-322) it is set at 1 .7 kg/cm2





- (6) Pressure drop of bottle (PS-304) it is set at 4.0 kg/ cm2g
- (7) Gas temperature rise in the machine (TY-321) it is set at 750C
- (8) Alarm for oil and water leakage (LS-303) (LS-304) it is set at 800 cc

Note:

Purity meter replacement analyzers shall draw samples from main, Turbine End and Collector End like existing arrangement.

Panel Front Items for Replacement

No.	Item#	Instrument Description	Range	Tag
1	TY - 321	Machine Gas Temp. Indicator	-10 ~ 110 C	G-TI-HG-008
2	MY-322	Scavenging Gas Purity Indicator (Tur. End)	50 ~ 100 % H2	G-AI-HG-009
3	MY - 321	Machine Gas Purity Indicator	50 ~ 100 % H2	G-AI-HG-008
4	MY - 323	Scavenging Gas Purity Indicator (Col. End)	50 ~ 100 % H2	G-Al-HG-010
5	-	Ammeter	0 ~ 500 mA	G-II-HG-008
6	•	Ammeter	0 ~ 500 mA	G-II-HG-009
7	٠	Ammeter	0 ~ 500 mA	G-II-HG-010
8	-	Red / Green Signal Lamp Gas Dryer Heater	-	
9	PI - 321	Machine Gas Pressure Indicator	0 ~ 4 Kg /Cm ²	G-PI-HG-007
10	FI - 322	Flow Meter	400 ~ 3000 CC/Min.	G-FI-HG-009
11	FI - 321	Flow Meter	400 ~ 3000 CC/Min.	G-FI-HG-008
12	FI - 323	Flow Meter	400 ~ 3000 CC/Min.	G-FI-HG-010
13	-	Valve Box		

Item # 15 Fault Indicator for Replacement







Spare	Spare	Scavenging Gas	Machine	Gas	Cont Air	Emrg Seal Oil	Emrg	Seal	Seal Oil Disc P
		Turbine End	Purity Low		Sup	pump Mot	Seal Oil	Oil	Low
		Purity Low			Trouble	overload	pump	Diff P	
							Mot	Low	
							Start		
1	2	3	4		5	6	7	8	9

Turb End Seal AC Exciter Cooler H2 Panel Gas Leak
Level High

10 11 12

Item # 16 Fault Indicator for Replacement

Machine	Machine	Scavenging Gas		Water 7	H2	Gas Spare	H2	H2 Purge
Gas P	Gas P	collector End	Machine	Oil	dryer	Mot	supply	trouble
High	Low	Purity Low	Gas T High	Leakage	trip		P Low	
1	2	3	4	5	6	7	8	9

Collector End Seal DC Source Failure AC Source Failure
Level High

10 11 12

Instrument Panel Inside Replacement Items

Item#	Instrument Description	Range	Tag
PX-321	Gen H2 Gas Pressure Transmitter	0~4 Kg/Cm2G	G-PT-HG-006
AX-321	Gen H2 Gas Purity Transmitter	50 ~ 100 % H2	G-AT-HG-012
PS-321	Gen H2 Gas Pressure Switch High	0 ~ 10 Kg /Cm ² G	G-PS-HG-006-1
PS-322	Gen H2 Gas Pressure Switch Low	0 ~ 10 Kg /Cm ² G	G-PS-HG-006-2

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Control Switch for Replacement

CS#	Service	Mark Plate
CS-1	Seal Oil Pump	Stop - Start
CS-2	Emergency Seal Oil Pump	Auto - Hand
CS-3	Gas Dryer Blower	Off - On

2- PURGING CONTROL PANEL

The gas purging control panel is wall mount type and is provided with a purity meter having double readings, one of which indicate purity of carbonic acid gas and the other indicates hydrogen purity and also provided with the underground room where gas purity is measured and needle valve which controls flow quantity of the carbonic acid gas, hydrogen and gas to be measured, the flexible hose to be connected to the outlet pipe of the gas for correction use and also is provided with constant voltage system.

Replacement of purging Panel will be with new analyzer installed within the replacement panel drawing out samples like existing source and arrangement,

The purity meter is, like gas purity meter, the heat wire type purity meter by which purity can be known utilizing heat conduction of the gas and has two kinds of scale, one of which indicates 0-100% of air purity and the other indicates 0-100% of hydrogen purity contained in carbonic acid gas.

2.1.1 Work includes the following:

- 1- The Contractor shall provide all materials, labor, equipment, tools, and consumables as necessary for the removal of old panels and system, and installation, testing and commissioning of the new state-of-the-art Hydrogen Control Panel and the Purging Control Panels in each GTG units
- The Contractor shall supply all material handling equipment including, crane scaffoldings, safety equipment, consumables, and other temporary works
- 3. Define system requirement, provide detail design, and equipment configuration, and documentation implementation
- 4. The system will be installed, wired/cabled, energized and placed in operation by the contractor. Cable, conduit, tray and supports shall be installed as necessary.
- The contractor's work shall include but not limited to the following:
 - a) Disconnection of wires and cables and save them in identified condition for reuse.
 - b) Disconnection of piping and tubing
 - c) Demolish the existing Hydrogen Control Panel and the Purging Control Panel
 - d) Handing over of dismantled panels to Marafiq warehouse for future use of items as spares for other units
 - e) Install the new Hydrogen Control Panel and the Purging Control Panel.
 - f) If any amendment or modification is required for fixation of new panels, then carrying out the necessary
 - g) Reconnection of cabling including connection to MARAFIQ DCS and to Power Supply
 - h) Reconnection of tubing
 - i) Testing





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- j) Provide all on-site startup/commissioning services. The startup services shall include but not limited to the following:
 - 1) Check and verify all I/O connections.
 - 2) Apply power to the new panels / system.
 - 3) Adjust, calibrate, and configure all field installed instrument / transmitters/equipment.
- k) Contractor shall provide calibration standard sample cylinders with necessary pressure regulators, connections and fittings. These cylinders shall be piped and connected to the purity system wet cabinet with necessary selection and isolation valves. This shall be possible to isolate the machine gas from the system and do calibrations check for the system by feeding H2 and CO2 gases from the pre piped sample cylinders.
- 6. Provision of H2 gas detectors in H2 control panels for detecting any gas leakages. The H2 Analyzer cabinet shall be fitted with Hydrogen leak detector of internationally standard make. The supply shall include necessary testing hardware to actually test the detector during the commissioning time. Signals shall be wired, connected and configured in Marafiq DCS. This feature does not exist in present panels.
- A mimic diagram shall be pasted on the cabinets showing the P&ID arrangement so that
 operators and maintenance can quickly relate the physical equipment arrangement and the
 intended function.
- 8. Handing over to Marafiq in fully operational form

2.1.2. INTERFACE WITH EXISTING DCS (Locally known as UCS)

- Signal transmission work shall be carried out to make display the existing signal for collective alarm in MARAFIQ Local Facilities and Central Control Room of Central Control Building
- b. This work for existing signal does not include any cable lay down or configurations. Only the existing features are to be retained using the existing cables. However integrity is to be established by testing up to the displayed function.
- For the additional signal of Hydrogen Leak Detection, cable shall be laid from Hydrogen Panel to DCS cabinets in Building 11 A. Configuration shall be done in Marafiq DCS.
- d. Work to integrate the Hydrogen Purity signal and Hydrogen pressure in the Marafiq DCS by lay down cable work from analyzer output of 4 ~ 20 mA to DCS cabinet in Building 11 A and configuration in DCS shall be quoted as an option to be finalized by Marafiq.
- e. Any additions or modification in instruments / signals critically required for replicating the total
 functionality not covered in this document shall be provided after approval by MARAFIQ prior
 to implementation.
- f. The Contractor shall interface and integrate hydrogen purity and hydrogen pressure signals to existing ABB Symphony Harmony DCS. The Contractor shall utilize existing spare inputs of PCU cabinets installed in building#11A. The Contractor and his sub-contractor (ABB) shall do the cable laying, termination of the required signals in existing PCU cabinets. The Contractor shall modify develop, configure or modify graphics, configure the tags for new signals and update the existing tag database and develop alarms for new signals in UCS.



An introduction for the MARAFIQ DCS is being given here-under for Contractor's guidance:





In the existing arrangement an enterprise-wide Unified control System (UCS), a Load Dispatch Center (LDC) and a Management Information System (MIS) are installed at MARAFIQ Yanbu Power, Desalination and Seawater Cooling facilities, provided under the YANPET Infrastructure Expansion Project, Contract No. 23635-C004-LDC and UCS.

The UCS is provided with Tenore MS Windows NT operator Workstations, 'Composer' series Windows NT Engineering Workstations (EWS) and 'Harmony' series Bailey local Process Control Units (PCU) based on a 'Symphony' Enterprise Management open architecture DCS supplied by Elsag-Bailey & Hartman & Braun Co. (EB&HB), of Genoa, Italy. The MIS is based on MS Windows NT client PC stations connected to a common 'Oracle' database server and application program server through redundant fiber-optic WAN supplied by the same vendor. The common backbone process LAN and local process control LAN's are redundant fiber-optic Bailey Co. proprietary C-Net LAN. For a better understanding, system overview is attached herewith, which is an extract from document UCS-EB-0537.

3- ELECTRICAL SYSTEM & EQUIPMENT

Materials & Installation

All electrical system, equipment and auxiliaries might be required for the scope of work defined above, shall be designed, manufactured, tested, installed and commissioned in accordance with the relevant sections of the technical specifications and applicable parts of referenced Codes and Standards.

The contractor shall provide materials and equipment that are new, of the type and quality specified, standard products, in compliance with referenced standards and adequately described by published product information.

The equipment supplied shall generally conform to the following minimum requirements:

1. Miniature Circuit Breakers:

Circuit breakers shall be of molded case type conforming to NEMA Standard AB-1. The circuit breakers shall be quick-make, quick-break with thermal magnetic trips, suitable for operation at 40 degree Centigrade or shall be ambient temperature compensated.

The interrupting rating for circuit breakers in panels shall be not less than the 10KA rms symmetrical values

2. Cables/ Wires:

Low voltage wire and cable (600V nominal)

Conductors: Conductors shall be uncoated, annealed, solid or stranded copper. Insulation shall be heat, oil, moisture and ozone resisting compound suitable for 90 Deg C maximum conductor temperature rise.

The conductors shall be sized based on capacity, short-circuit level and voltage drop limit requirements.

Voltage drop shall be limited to 3 % on load circuits.

Ground wires shall be annealed, bare or green color insulated copper. Color codes for phase identification in wires shall be as follows:

hase A - Black

Phase B - Red

Phase C - Blue

Neutral - White

Ground - Green

If available cable does not have colors corresponding to the table, color bands of tape shall be applied to all exposed ends of conductor insulation.

Neutral wires shall be the same size as phase wires.

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Grounding:

All electrical equipment, metal framework, metal conduits etc. shall be securely fastened to the main ground grid. The size of the ground cable shall be the same size as the size of phase conductor. All conduits shall be electrically continuous and grounded.

Accessories:

The pull box, junction box and terminal box shall be of weather proof construction.

The conductor terminals / lugs required for termination on bolt or screw terminals shall be tin plated copper, compression type.

The insulation tape (plastic / rubber) shall be pressure sensitive adhesive.

All exposed conduits shall be of Rigid Aluminum Alloy.

Underground conduits shall be PVC Series 5, resistant to moisture and chemical atmosphere.

Underground conduits at Road Crossing shall be encased in concrete.

Couplings, connectors and fittings shall be compatible with the conduits and equipment and devices where conduits are terminated.

PVC fittings shall be liquid tight. When continuing above ground, use rigid steel vertical riser with PVC to steel adapter and steel coupling extending above the top of concrete.

Cables and conduits passing through firewalls shall have fire stops. Fire stop assemblies and materials shall be UL listed or approved equal.

Each conduit / cable runs shall be identified by means of brass or aluminum ribbon tags with identification legend.

Conduit support shall be provided at every three (3) meters interval, from existing structures/beams/columns wherever available, and by means of additional hot dipped galvanized steel channels, as required. All screws or bolts shall be hot-dipped galvanized for outdoor use or cadmium plated or equivalent for indoor use. Conduit straps and brackets shall be installed, as required.

The cables are to be laid in existing cable trays, pipes, ducts wherever they are available, otherwise new cable trays, conduits, clamps and structural supports required for terminations of cables shall be provided by contractor. Quantities and layout details shall be engineered by the contractor.

4- INSTRUMENTATION & CONTROLS

4.1 General

- Presently the H2 Purity meters existing are of the type Thermal Conductivity Sensors, which are prone for drifting. Hence, in order to overcome the drifting, it is advisable to go in for the "Non-Thermal Conductivity type". Marafiq has retrofit experience in STG, where vibration principle based sensor is working without drift for prolonged period, whereas the Thermal conductivity sensors type as installed in GTG plant are prone to drifting problems as observed here and elsewhere in other plants. Also it shall be noted that the GTG H2 purity meters are showing low H2 purity readings.
 - Hence this specification is calling for change to vibration type measurement of H2 Purity sensor.
- b) The quoted H2 purity meter must have been field proven on similar GE Gas Turbine Generators and the sensor shall not become obsolete and shall be supported for spare parts for at least 20 years.
- The units for pressure shall be Kg/Cm² and temperature in Deg C.
- d) Sensor Transmitter shall be microprocessor based with Built-in Self diagnostic features to initiate immediate alarm on fault.

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MARAFIO PROCURĒMENT A CONTRACTS DEPT.

- e) Instruments shall be state of art, "SMART" Electronic equipment and shall be designed to operate properly under extreme environmental conditions possible at the site, in particular over an ambient temperature range of 6°C to 60°C and 100% humidity at each instrument installation. Temperature, pressure, flow instruments/transmitters shall utilize solid-state electronic components with SMART capabilities.
- f) All SMART transmitters shall operate in the analog mode for output of 4 $^{\sim}$ 20 mA with HART signal superimposed. All transmitters shall be furnished with enclosures pertinent to area classification and suitable for outdoors.
- Transmitter/s shall have high accuracy (± .075% of span) and longer stability (± 0.1% URL for 5 g) years) suitable for Class1, Div.1 for hydrogen monitoring/alarm functions.
- h) Installation of instruments shall meet the requirements of the manufacturer's written instructions and recognized industry practices complying with requirements to serve the intended purpose. Installation practices of all instrumentation and controls shall conform to American Petroleum Institute (API) Installation standards, API RP 550.
- i) Tubing and piping connections for instrument and impulse lines shall conform to requirements contained in the Specification. All new impulse tubing or new interconnections to instruments shall be type 316 L, stainless steel unless process requires other materials.
- j) Cable installation, including all wiring, for instrument and control systems shall conform to requirements of the specification. Manner of entrance of conduit and cable tray transitions into enclosures shall conform to requirements of the area.
- k) Area classification requirements of Class 1, Division 1, Group C and D or Zone 1 areas, classified under NFPA 70, National Electrical Code (NEC) shall be met. It shall apply to all the instruments, signals and supply provisions. All cable gland connections to the wet cabinet shall also be Class 1 Division 2 suitable for Hydrogen gas application.
- I) Analog signal cabling (if required) shall be 2C x 1.5 mm², single-twisted or multi-twisted pairs of copper conductor shielded, 600V insulation class, XLPE, fire retardant.
- m) Connectors-lugs for power and instrument conductor terminations shall be tin plate copper, ring tongue, compression crimping with insulated sleeve.
- n) A white heat and moisture resistant, non-metallic terminal marking strip shall be provided on each terminal block and the terminals shall be identified exactly as they are on the wiring diagrams.
- o) Cable sealants shall be used as required.
- p) Tried and tested equipment shall be used, that is, minimum of three years of successful operation. Instrument specified shall generally not be approaching obsolescence and shall have maintenance spares available for a period not shorter then 20 years.
- q) Power supply and signal wiring shall be in separate channels in the cabinets and in the field.
- Instruments shall have SS tags with numbering and description as per existing philosophy. r)

s) Tubing shall not put strain to instruments.



- t) Ensure appropriate sample flow as necessary for the new hydrogen monitor / analyzer.
- u) The equipment installation and commissioning will involve flammable gas (hydrogen) under pressure. Appropriate measures must be taken to prevent leaks and to avoid sources of ignition.
- v) Any equipment affected or damaged during the execution of work by the Contractor and not required to be replaced according to the scope of work, shall be restored to its original condition by the contractor, at no cost to the Marafig.
- w) Bidders shall indicate in their proposal, what Range of Hydrogen Purity, the proposed system can measure? Whether it is 85-100% or 0-100% corresponding to the 4-20 ma signals connected to the DCS.

4.2 Panels Specifications

a. Enclosures

All enclosures shall be a minimum of weatherproof, water and dust-tight in accordance with NEMA Type 4X or IEC 60529, Protection Degree IP 66, and suitable for the electrical area classification as specified by NEC.

b. Cabinet

Enclosure and Frame Structure

- The Hydrogen Control Panel shall be a free standing, front and rear access, and rigid, self-supporting structure, whereas Purging Control Panel will be a wall mounting type.
- ii. The panel enclosure shall utilize a welded angle frame augmented by steel components such as floor channels, top sheets, end trims and wiring trays. Panel shall be suitable for mounting on existing level structural steel members embedded in concrete floors.
- iii. Basic panel assembly shall be fabricated from not less than 3/16 in. (4.8 mm) thick sheet steel, selected for flatness and smoothness and free from surface defect. Where possible, the panel fronts shall be one continuous sheet of steel.
- iv. The Hydrogen Control Panel shall be the vertical type.
- v. The external surfaces of the panel shall slope uniformly in one direction from the edges of the panel to the point of maximum deflection. Wavy or wrinkled surfaces are not acceptable. The following maximum deviation from a plane surface shall not be exceeded:

 Panel Dimension
 Maximum Deflection

 Up to 32 in. (81.28 cm)
 3/32 in. (2.4 mm)

 32 in. (81.28 cm) and up
 1/8 in. (3.2 mm)

- vi. All exterior surfaces and joints of the panel shall be free of any defects due to the manufacturing process such as welding, riveting, cutting or punching. No bolt heads or rivets shall be visible on the exterior surfaces. All surfaces and edges shall have full-height rear door (s).
- vii. Panel enclosures 32 in. (81.28 cm) or more in width shall have double-swing doors. Panel and cabinet enclosures less than 32 in. (81.28 cm) in width shall have a single swing door. The door (s) shall be flush mounted, fabricated from not less than 1/8 in. (3.2 mm) thick sheet steel, with edges turned back 90 degrees for rigidity. Doors shall be removable, with concealed hinges and three point latches with T handle and lock. All door hardware hinges, latches, and locks shall be stainless steel.

All door locks shall be keyed alike. A set of three keys shall be provided.



- viii. The panel enclosure, frames, components and instruments shall be able to withstand, without any damage, all stresses encountered in the process of handlings, shipping and installation.
- ix. The panel shall be provided with removable lifting eyes or angles.
- x. Indicating lights and annunclators used on the panel shall be re-lampable from the front and shall use long life bulbs.
- xi. All components and devices in the panel shall be mounted in a manner permitting all necessary adjustments and removal to be performed easily and without disturbing adjacent parts. Front accessible adjustments and test connections shall be used on instruments frequently requiring tests or adjustments.
- Appropriate brackets or sub-panels shall be provided for all devices and components mounted inside the control panel. No direct attachment of components to outside walls shall be permitted.
- xiii. Molded case breakers and fuses shall be provided and mounted inside the panel in visible and easily accessible locations.
- xiv. Instruments and control requiring removal from the panel for maintenance shall be provided with a cable loop of sufficient length to remove the instrument without requiring disconnection of the cable.
- xv. The joints between panel plates shall be welded and grounded accurately, so that when painted these joints will not be visible. All control panel sides shall be bent with approximately 1/2 in. (0.13 cm) inside radius.
- xv. Wiring shall run in rigid steel conduits. All terminations and connections shall be done in standard outlet boxes.
- xvii. A disconnecting device shall be provided for the MARAFIQ incoming service supply. This can be appropriately rated safety switch or a non-automatic molded case circuit breaker.

4.3 Testing and Inspection

- 1. All materials shall be inspected visually for damages and defects.
- The contractor shall fully test the new hydrogen control panel and the purging control panel. This includes verification of all intended alarm and monitoring functions. The contractor shall demonstrate full system functionality prior to system acceptance.
- 3. All testing shall be scheduled at least five days in advance to allow sufficient time for advising Marafiq representatives to witness the test.
- 4 Defects noticed during testing shall be repaired by the contractor at his own cost.
- 5. Marafiq I&C representative shall attend testing and inspections.

4.4 INTERFACE

Contractors shall be responsible for making the physical connection of all Piping, Tubing, Cable Connections, Electrical Power System and MARAFIQ DCS associated with Existing System. The contractor shall develop the details of interface requirements and verify the connectivity of the existing system and information furnished. The contractor shall notify MARAFIQ of all and any required corrections.

The contractor shall be responsible for making the physical connection at all the following interface of the existing system, unless otherwise indicated, the interface shall include, but not limited to the following services.

- Electrical & Power connection
- MARAFIQ DCS (UCS) Interface
- Piping and tubing to the field
- Wiring

4.5 STANDARDS AND CODES

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Following standards must be considered:

- A. American National Standard Institute (ANSI)
- B. American Society for Testing and Materials (ASTM)
- C. National Electrical Manufacturer Association (NEMA)
- D. National Electrical Code (NEC)
- E. International Electrochemical Commission (IEC)
- F. American Petroleum Institute (API)
- G. National Fire Protection Association NFPA
- H. Instrument Society of America ISA

4.6 APPENDICES

Annexure 1 Existing DCS Description

Copy of Existing DCS Description (Unified Control System (UCS) Contract No.23635-C-004) Document # UCS-EB-0537 is attached here with.

Annexure No.2: Existing Equipment Description

A. Safety Documents

- Basic Safety Rules per document
 MCCP-1-LP-001
- 2. Contractor Compliance with Safety Rules

B. Reference Drawings List

The following drawings are being provided for reference only.

- 1. Catalogue Cut TG-06, Gas Control (Hitachi)
- Dwg. No. 10Q 125-459 Diagram of Hydrogen Control System
- Drg. No. 10R 192-139 (5/7) Arrangement of Piping for Hydrogen Control System, Unit 1
- Drg. No. 10R 198-072 (6/7) Arrangement of Piping for Hydrogen Control System, Unit 2
- 5. Drg. No. 10R 192-140 (7/7) Arrangement of Piping for Hydrogen Control System, Unit 1 ~ 4
- 6. Drg. No. 331 DF2 2962 G35A, Elementary Diagram Instruments for Hydrogen Panel







- 7. Drg. No. 331 DF2 2962 G35B, Elementary Diagram Instruments for Hydrogen Panel
- 8. Drg. No. 331 DF2 2962 G36A, Elementary Diagram Instruments for Hydrogen Panel
- 9. Drg. No. 331 DF2 2962 G36B, Elementary Diagram Instruments for Hydrogen Panel
- 10. Dwg. No. 331RF17889 Arrangement of Gas Purging Panel
- 11. Dwg. No. 331QF28387 Arrangement of Hydrogen Control Panel
- 12. Dwg. No. 331RF17890 Name Plate List Hydrogen Control Panel
- Dwg. No. 10R192-139/140 Arrangement of piping Hydrogen Control System
- 14. Dwg. No. 331QF15184 Outline of Aux. control Compartment







SECTION – IV O REPLACEMENT OF AVR BY DIGITAL EXCITATION SYSTEM FOR GTG UNITS 1, 2, 3, 5, 7 & 8





I. GENERAL REQUIREMENTS

1. Project Objective

The objective of this project is to upgrade the existing Excitation System including Automatic Voltage Regulation (AVR) by replacing obsolete ones, with the latest Digital type Excitation System & Automatic Voltage Regulators (D-AVR) for Gas Turbine Generators (GTGs) No. 1, 2, 3, 5, 7 and 8 Of MARAFIQ at Yanbu.

2. Project Location

This project is related to the MARAFIQ facilities complex in the Industrial City of Yanbu which is located at latitude of 24° 00′N, and longitude of 38° 10′E. It is relatively flat, rising 10m from the shoreline to the regional highway, which is the northeast boundary of the city development. The works of the project shall be located within the complex.

3. Program Requirements

The program requirements for this project is the replacement of an existing Excitation System including Automatic Voltage Regulators (AVRs) for Gas Turbine Generators (GTGs) No. 1, 2, 3, 5, 7 and 8 with the latest generation of Digital type Excitation System & Automatic Voltage Regulators and carry out subsequent modification work in the existing installations as well as UCS/DCS and mark-VIe systems.

This shall also include dismantling and removal of existing installation of Excitation System & AVRs and related accessories of the generator excitation systems at site.

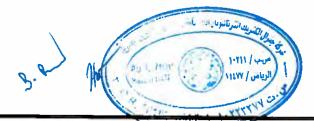
4. Bidding Requirements for the program

The Bidders are required to prepare and submit their bids for replacement of existing obsolete Excitation System including AVRs with the latest product of Excitation System & Automatic Voltage Regulator (AVR), for Six (6) of Gas Turbine Generators (GTGs) No. 1, 2, 3, 5, 7 and 8 of MARAFIQ at Yanbu. It is the sole discretion of MARAFIQ to release any of the unit (s) for implementation of the work under this Contract. Plant operation however, shall always be given priority over the contract work.

5. Reference Document

The following listed existing documents shall be accessible to the Contractor on request after award of contract. These documents shall be available for bidder's reference only;

Instruction Manuals for; PIC B-1216 Vol. 4 (Excitation System)





II. TECHNICAL REQUIREMENTS

1. General Scope of Services

The work to be performed under this Contract consists of furnishing labor, supervision, tools, equipment, technical and professional services, materials supplies and all articles necessary to perform work involved in replacement of existing Excitation System & Automatic Voltage Regulators (AVRs) with the most up-to-date generation of Digital type Excitation System & AVR as well as integration with the UCS/DCS and Mark-VIe systems for Gas Turbine Generators (GTGs) No. 1, 2, 3, 5, 7 and 8 at Power & Water Complex facilities of MARAFIQ Yanbu.

2. Engineering and Design Responsibilities

- 2. 1 The required professional services shall include complete design development, including the review of information provided in the contract documents, preparation of the final as-built drawings and all necessary documents as required, and related other professional services in connection with, as specified herein, except as may be specifically excluded in the contract document.
- 2. 2 The engineering and design responsibilities, under this Contract, shall include to obtain, research, and apply design information on relevant existing systems design documents/ drawings by utilizing technical documents from the Owner's files.
- 2. 3 The Contractor shall conduct feasibility study and suggest suitable latest state of art digital excitation system for existing GTG sets after carefully studying the present arrangement of the excitation system. This feasibility study shall be presented to MARAFIQ representative for their review and approval.
- 2. 4 Engineering responsibilities shall include the detailed engineering for manufacturing of AVRs as well as the engineering and design of operational parameters of Digital type Excitation System & AVR, MEL, OEL, LDC, V/Hz, PSS (Power system Stabilizer) with their calculations.

3. Applicable Codes and Standards

A) Safety

- UL508A Safety Standard Industrial Control Equipment
- CAN/CSA 22.2 No. 14 Industrial Control Equipment
- UL 796 Printed Circuit Boards
- ANSI IPC guidelines
- ANSI IPC/EIA guidelines

B) Electromagnetic Compatibility (EMC) Directive 89/336/EEC

- EN50081-2 General Emission Standard
- EN 55011:1991 ISM equipment emissions (CISPR 11)
- EN 50082-2:1994 Generic Immunity Industrial -Environment
- EN 61000-4-2 Electrostatic Discharge Susceptibility
- ENV 50140:1993 Radiated RF Immunity
- EN 50141 Conducted RF Immunity
- EN 61000-4-4 Electrical Fast Transient Susceptibility
- EN 61000-4-5 Surge Immunity







C) CE - Low Voltage Directive 72/23/EEC

- EN 50178 Electronic equipment for use in power installation 1995
- EN 60439-1 (Panel Program)

D) CE - Machinery Directive 89/392/EEC

- EN 60204-1 Electrical Equipment for Machines
- EN 292-1 Basic Terminology, Methodology
- EN 954-1 General Design Principals

E) IEEE

- 421.1 Standard Definitions for Excitation Systems for Synchronous Machines
- 421.2 Guide for Identification, Testing, and Evaluation of the Dynamic Performance of Excitation Control Systems
- 421.3 High-Potential Test Requirements for Excitation Systems for Synchronous Machines
- 421.4 Guide for the preparation of Excitation Systems Specifications
- 421.5 Recommended Practice for Excitation Systems for Power Stability Studies
- C57.12.01 General Requirements for Dry-Type Distribution & Power Transformers
- C37.90.1 Surge Withstand Capability (SWC) tests for Protective Relays & Relay Systems
- C57.18.10 Practices and Requirements for Semiconductor Power Rectifier Transformers,
- C57.110 Recommended Practice for Establishing Transformer Capability when Supplying Non-Sinusoidal Load Currents
- C57.116 Guide for Transformers Directly Connected to Generators
- C37.90.1 Surge Withstand Capability (SWC) tests for Protective Relays & Relay Systems
- C57.18.10 Practices and Requirements for Semiconductor Power Rectifier Transformers

4. Technical Submittals

Contractor shall submit to MARAFIQ for review and approval of the following:

- a. Before commencing the work, submit Shop Drawings on standard A1 size indicating details and dimension
- b. The Drawings and documents shall include Digital type Excitation System & D-AVR specification diagram, cubicle out line, schematic for I/F with other equipment, recommended parameters of AVR, MEL, OEL, LDC, V/Hz, with calculations, assembly and termination diagrams.



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- c. The Contractor shall submit copies of catalog for all materials and products including manufacturer's certification that the materials complying with the required standards/specifications.
- d. All materials, cables and wires and other misc. items required on this project shall be submitted for approval before procurement.
- e. The Contractor shall submit installation/erection drawings for new equipment and demolition drawings for existing to remove under this proposed modification.
- f. The Contractor shall submit a detailed method statement for installation and termination of proposed equipment in the panels.
- g. The Contractor shall submit Operation & Maintenance Manual(s), containing of trouble shooting instructions and manufacturer's Recommended Spare Parts List with supporting literatures.
- h. The Contractor shall submit commissioning procedures for commissioning.

4.1 SUPPLY AND PROCUREMENT

The Contractor shall be responsible for the supply and delivery to site of all equipment, materials and supplies required for accomplishing and performing the work.

4.2 INSTALLATION & CONSTRUCTION

The Contractor shall be responsible to perform complete installation work, as specified, conforming to the MARAFIQ approved procedures, professional standards of skill; performing work of a similar nature. Unless otherwise expressly provided herein, all materials and equipment shall be new and shall conform to the specifications, drawings, samples and other descriptions set forth in this contract or provided by contractor and approved by MARAFIQ

4.3 INSPECTION AND TESTING

- 4.3.1 Within fifteen (15) days after the notice of award of the Contract, Contractor shall submit an inspection and testing plan, in two parts, covering off-Site and on-Site activities, for MARAFIQ's review and approval.
- 4.3.2 MARAFIQ reserves the right to witness all or part of testing and inspection activities per approved plan. MARAFIQ or its authorized Representative / 3rd party may witness such activities. Test records shall be submitted for the entire system.
- 4.3.3 The Contractor shall provide and arrange free access thereto upon reasonable advance notice in writing, for all off-site testing, to proceed for witnessing test activities by MARAFIQ representative.
- 4.3.4 The Contractor shall carry out all off-Site and on-Site inspection and testing of the entire system. The MARAFIQ shall have the right to reject any part of the work reasonably found unsatisfactory or not acceptable on the basis of results of such inspection and testing.
- 4.3.5 The Contractor shall give at least one-day advance notice to MARAFIQ to witness any of the on-site test and inspection activities per approved schedule.

4.4 RECOMMENDED SPARE PARTS

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- 4.4.1 The Contractor shall prepare and submit a list of recommended operational spares for three (3) years of life of the AVR system with their cost.
- 4.4.2 The Contractor shall submit RSPL of each piece of equipment followed by the technical approval of the Preliminary Equipment list (PEL) by MARAFIQ. The Contractor shall promptly update the submittal and proceed in line with procedure.

4.5 QUALITY ASSURANCE

The Contractor shall be responsible to ensure that all engineering, construction, materials, equipment and workmanship provided under this Contract is in compliance with the Contract provision applicable codes and standard and sound engineering and construction practices.

4.6 START UP & COMMISSIONING

4.6.1 PRE-COMMISSIONING

- a) Visual inspection of completed work shall be performed after application.
- b) Insulation resistance test shall be performed on all electrical and control components and cables.
- c) Physical checks of all electrical termination and related installation
- Megger the insulation and continuity checks of all wiring to ensure proper connections and grounding

4.6.2 COMMISSIONING

Commissioning and startup of the entire installation shall be carried out by the Contractor and witnessed by the MARAFIQ representative. This shall include all necessary, material, test equipment, tests on installation to put the facilities to operation

4.7 PERFORMANCE TESTS AND ACCEPTANCE

The Contractor shall be responsible to carry out all the system performance tests as specified in the technical specifications. The MARAFIQ will, following delivery of the request by the Contractor, witness all required tests and either indicate its acceptance or notify the Contractor about the deficiencies which are discovered and are required to be completed by the Contractor within mutually agreed time limit. Upon completion of specified deficiencies, MARAFIQ either indicate the acceptance or give Contractor notice of failure to complete the work or correct the specified deficiencies.

4.8 TRAINING AT SITE

The Contractor shall be responsible for providing necessary Training to the MARAFIQ Operation & Maintenance personnel, in order to operate and maintain the system installed under this project. Excitation training including the AVR shall be provided to 5 MARAFIQ technical staff and shall be arranged at vendors training site. It shall include minimum trouble shooting, Online & Offline simulation, adjustments of excitation parameters etc. The training shall be provided for both system operation and maintenance of the equipment. Course materials, training aids and qualified instructor shall be provided by the Contractor.

The on-site training shalf include but not limited to the following coverage;

1) For Operation

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- -General D-AVR
- -Startup of Excitation
- -Shut down of Excitation
- -Voltage adjustment
- Changeover MVR/AVR
- -Alarm system
- -Procedure for Abnormal operations

For Maintenance

- -General D-AVR
- -operation of D-AVR
- -Periodical Maintenance
- -Replace the failure card & other components
- Fault finding and Trouble shooting

5. Project Description

The work related to this project is the complete replacement of existing obsolete Excitation System including analogue type automatic voltage regulators (AVR) for Gas Turbine Generator (GTG) with the latest generation of Digital type Excitation System & automatic voltage regulators (AVR), and carry out subsequent modification work in the existing installation as well as UCS/DCS and Mark-VIe systems.

This also includes dismantling and removal of existing Excitation System including analog type of AVR's and accessories of the generator excitation system from the site.

Existing Excitation system comprise of Main Exciter, Pilot Exciter, Silicon rectifiers & Automatic Voltage regulator. The details of present excitation system are given in GTG GEN. AVR & Excitation DATA attached with this scope of work.

The existing Excitation System can be replaced as whole with sophisticate excitation system such as GE EX2100e Excitation System or equivalent to be compatible with existing GTG sets. It may be replaced with an Excitation Transformer of suitable rating or Single exciter with brush/Brushless type exciter to be matched to our existing generator capacity after conducting feasibility study as described in clause 2.2.3 of this scope of work.

6. Scope of Supply

The scope of supply of this Contract includes all engineering, design, and procurement, construction, testing and commissioning necessary for the replacement and satisfactory operation of existing obsolete AVR/Excitation system with latest product of state of art Digital Excitation System & AVR's. It includes but not limited to the following:

- a. The Contractor shall provide a complete set of latest production of Digital Excitation System & Automatic Voltage Regulator (AVR) system compatible with the existing UCS/DCS and mark-VIe systems for four units of Gas Turbine Generators GTG-1 to 4, to substitute the existing ones.
- b. The Contractor shall provide manufacturer's recommended spare parts for minimum three (3) years of operation in addition to parts that may be required during commissioning and or trial operation.
- c. The scope of supply shall include a set of special tools for installation, testing, commissioning and maintenance for new installations and modification of the existing installations.



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- d. The scope of supply shall also include services and materials for decommissioning and removal of the existing excitation system & AVRs' and installation of the new Digital Excitation System & AVRs' equipment integration with the existing UCS/DCS and mark-V systems.
- e. The Contractor shall be responsible to supply services and all necessary materials including wiring and cables & accessories for new installations as well as modification and or replacement of the existing wiring & termination, mounting hardware that may be required, for new AVRs installation.
- f. The scope of supply shall also include vendor's supervisory services for testing, commissioning, trial run and performance-testing for the new AVR installation, to the entire satisfaction of Marafiq.
- g. The scope of supply shall also include the relevant software for Automatic Voltage Regulators which realizes all job functions and features of the system

7. Equipment and Materials

- 7.1 The material includes all necessary modules for a dual redundant Digital type Automatic Voltage Regulators (D-AVR) compatible; for integration with the existing plant wide DCS/UCS and operable from Local Control Rooms as well as in CCR (same as existing system). It also includes all materials required for implementation and subsequent modification work of the existing excitation system installations. The equipment shall include but not limited to the followings;
 - A) CPU unit
 - CPU Cards (dual cards)
 - Analog input Cards (dual cards)
 - Digital input Cards (dual cards)
 - firing pulse control Cards (dual cards)
 - B) Thyristor Rectifier Unit (Power unit) 2 including 1 redundant Field circuit breaker, voltage and current transducers, discharge- resister
 - AVR cubicles (Manufacturer's Standards) subject to be approved by MARAFIQ
 - D) Existing PTs, CTs shall be renovated, as necessary, to be reused.
 - E) All necessary materials including wires and cables for new installations, as well as modification and or replacement of the existing ones.
- 7.2 The Contractor shall provide and install all additional hardware/software for mark-V and UCS systems necessary for integration of new AVR in to the existing system.
- 7.3 The Contractor shall be responsible to provide industry proven equipment with at least 2 to 3 years of successful operation in power plants and or utility industries without any trouble and/ or break down record in the system.

8. System Description

- 8.1 The system supplied shall be a completely coordinated, reliable, and proven system, including all the necessary functions of control, protection and alarm customarily required for the operation of the electric generating stations of the power utilities. Any detail omitted in the specifications shall not relieve the contractor from supplying the intended system. The performance of the system shall be equal to the system employed.
- 8.2 All components shall be designed in accordance with, and shall meet or exceed the requirements of the appropriate ANSI, NEMA, and IEEE standards or equivalent. Where directly applicable standards are not available, related standards shall apply, such as for solid state or static devices, rectifiers, winding insulation class, level and potential, etc.
- 8.3 The system cubicle shall be metal enclosed with accessibility from front and rear, including necessary wiring, terminals, and switches or circuit breakers. Internal power, ground, and control buses, connectors fuses.

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terminal blocks, name plates, permissive control switches with indicating lights, shall be included. All internal devices for external connections shall be wired to terminal blocks with block and points suitability labeled. Controls circuits for the various components and functions shall be provided with the fuse disconnect switches.

- 8.4 The system shall operate successfully through any transient condition imposed by the generator, including operation at ceiling voltage, during field forcing. The base excitation system shall track the automatic regulator while the automatic regulator is in service to allow a bump less transfer to the base excitation upon loss of the automatic regulator.
- 8.5 The CPU software of Digital Automatic Voltage Regulator shall be realized with the following functions;
 - A) Control and Limiting Functions:
 - Voltage Constant Functions (AVR),
 This is a basic function Automatic Voltage Regulator.
 - ii. Field Constant Functions (MVR)

 The generator voltage can be operated manually, for testing purposes or in conditions of the PT signal failure or Analog I/P card failure.
 - iii. Minimum Excitation Limiter (MEL) The Minimum Excitation Limiter (MEL) shall be provided to limit the decrease of excitation below that which may result in pullout out of the generator.
 - iv. Over Excitation Limiter (OEL)
 The Over Excitation Limiter (OEL) shall be provided to limit the excitation to a safe value automatically. The OEL has inverse-time characteristics.
 - v. Line Drop compensation (LDC)
 The Line Drop compensation (LDC) shall be provided to boost the voltage at the generator as a function of flow of lead and reactive current to compensate for the main transformer impedance losses.
 - vi. Volts / Frequency Limiter (VFL)
 The Volts/Frequency Limiter (VFL) shall be provided to limit the decrease of excitation to prevent damage due to heating during low frequency operation.
 - vii. Power System Stabilizer of signal input type (PSS) (Electrical Power Input type) Power System Stabilizer (PSS) shall be provided to improve the damping of the system electromechanical oscillations. The PSS inputs signal will be an electrical power. The electrical power is detected from generator terminal voltage and current signal.
 - Monitor and Operation Functions
 - Operation / Alarm status
 - Parameter (monitor/setting)
 - C) Self diagnostic Functions
 - Automatic tracking and transfer from Auto (AVR) to Manual (MVR) function.
 - Basic hardware and software (WDT)
 - Analogue input Signal Monitor.
 - Pulse Loss monitor







- D) The system shall be provided with all alarms/and limit functions operation indications sent to the control room as well as monitored by graphic panel on the D-AVR panel.
- E) The system shall be provided with the following limiting and protection functions operation indications;
 - Minimum Excitation Limiter (MEL) operation
 - Over Excitation Limiter (OEL) operation
 - Volts / Frequency Limiter (V/Hz) operation
- 8.6 The Contractor shall be responsible for collecting information and subsequent design calculations about the transmission network (i.e. external reactance from Generator terminals to infinite bus) involved in working out parameters of PSS and MEL.
- 8.7 The AVR system shall be compatible for integration with the existing distributed control system (DCS) and operable from the GTGs local Control Rooms as well as from the GTGs Clusters (OIU) in the Central Control Room.
- 8.8 Contractor shall be responsible to fully integrate new AVR system into the Mark-VIe subsequent UCS/ DCS (Distributed Control System). And shall provide and install all additional hardware/software of mark-V, UCS systems required for interfacing the new AVR.
- 8.9 The power part of Digital Automatic Voltage Regulator with appropriate ratings shall be provided with the following components:
 - A. Thyristor Rectifier Unit
 - B. Field Circuit Breaker
 - C. Monitoring Devices

9. Non Material Requirements

The non-materials requirements for the enhancement of this stepping automation system—shall include but not limited to the followings;

- i. All composite Engineering packages, materials procurement proposals, manufacturing and test procedures and schedules.
- ii. Software and Hardware package.
- iii. Power and / or control schematic diagrams.
- iv. Sequence / logic diagrams
- Wiring diagrams.
- vi. Specification and Data Sheets.
- vii. Complete parts data package.
- viii. Installation and erection instructions.
- ix. Certified test reports, certificates, data and curves.







- x. Operating instructions.
- xi. Maintenance manuals / instructions
- xii. Bill of materials

All documents and associated drawings shall be in accordance with the latest revisions of applicable codes and standards.

10. Detailed Installation Requirements

- i. Disconnection and removal of existing excitation system including AVR panels and related wiring and connections.
- ii. Mounting/ installation of new excitation system including AVR equipment panels, separately in the GTG's Local Control Building.
- iii. Install/ terminate wiring from I / O modules to terminal blocks and other related auxiliary components.
- iv. Preparations of both ends of the wires for termination and making connections with respective terminal blocks after completion of the above work activities.
- v. All necessary installations and or system configurations for interfacing of AVR with the transmission network involved in setting parameters of PSS and MEL.
- vi. Installation and or system configuration works necessary for integration of the AVR system with the existing Distributed Control System (DCS), operable from the GTGs local Control Rooms as well as from the Clusters (OIU) in the Central Control Room.
- vii. Testing of wiring and components before and after the termination of all related equipment.
- viii. Quality assurance and quality control checks witnessed by the end user, for each step of installation, testing and commissioning activities.
- ix. Configuration
- x. Post-installation system configuration/re-configuration, testing & commissioning, trial operation and performance monitoring shall be carried out by vendors' specialist / expert supervision.
- xi. Grounding
- xii. Install and terminate grounding wires/cables and connect to the existing grounding network.
- xiii. Ground bonded all equipment and supports.
- xiv. Workmanship:
- xv. All installation work shall be carried out in a neat and clean workmanship like manners.
- xvi. Cable openings in equipment enclosures shall be suitably bused or edge-protected to eliminate any possibility of damage to wiring insulation.

11. Inspection and Testing

The entire excitation system including AVR system equipment is subject to undergo for routine shop tests and site acceptance tests. The Contractor shall submit a pre-dispatch Inspection & Test procedures and schedule for MARAFIQ approval. MARAFIQ reserves the right to witness all or part of these tests. MARAFIQ or their authorized representative may attend such inspection and testing activities. The Contractor shall provide and arrange free access thereto upon reasonable advance notice in writing. The test record shall be submitted for all auxiliaries.

These tests shall be classified but not be limited to the following listed categories:

11.1 Factory Acceptance Tests (FAT)

The entire equipment of the system shall go for factory tests including, but not restricted to the following;

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- i) Inspection of external appearance, Structure and dimension, Name plates and sign, electrical equipment, accessories and supports, painting and coating.
- ii) Measurement of insulation resistance
- iii) Dielectric Test (Voltage withstand Test)
- iv) Power Supply confirmation test
- v) Input/output interface check
- vi) Characteristics Tests

MARAFIQ shall have the right to witness the shop tests or may examine and review the engineering and test paper work only.

11.2 Site Acceptance Tests (SAT)

Post installation all equipment shall go through the extensive testing with appropriate reviews on the Factory Acceptance Tests results as above. These tests shall include but not limited to the following;

- i) Inspection of external appearance.
- ii) Measurement of insulation resistance
- iii) Dielectric Test
- iv) Power Supply confirmation test
- v) Input/output interface check
- vi) Static Characteristics Tests
- vii) Dynamic Characteristics Tests

The Contractor shall carry out the integrity test on the entire existing cables and the required cable replacement shall be done with no additional cost to the MARAFIQ.

12. Commissioning

The Contractor shall carry out the entire commissioning and energizing activities related to all new installations of automatic voltage regulators (AVRs) system by vendor's specialist, which shall be witnessed by the MARAFIQ representative at site. This shall include but not restricted to demonstration of post-modification complete system performance to the entire satisfaction of the end user department.

13. Appendices

Provided herewith are the following documents for reference only

- 1. 331-SM-19280-E02 Exciter Main Circuit (1) Elementary Diagram
- 2. 331-SM-19280-E03 Exciter Main Circuit (2) Elementary Diagram
- 3. 331-SM-19280-E04 Elementary Diagram
- 4. 331-SM-19280-E05 Elementary Diagram
- 5. 331-SM-19280-E24 Minor Trouble Elementary Diagram
- 6. 331-SM-19280-E26 Control & Lighting Source (AVR) Elementary Diagram
- 7. GTG GEN, and AVR & EXC. DATA.







SECTION – IV P INSTALLATION OF HVAC SYSTEM & HYDROGEN DETECTOR INSIDE DC COMPARTMENT FOR GTG UNITS 1-8







I. GENERAL REQUIREMENTS

1. Background

Marafiq is considering modification of Battery Room Ventilation and gas detection in MGTG DC compartment, The concern expressed that the battery rooms of GTG 1-8 in terms of hydrogen gas detection and existing ventilation systems of battery rooms. The batteries during the charging process emit hydrogen gas. The existing design of the battery rooms does not have provision for Hydrogen gas detectors. Hence in the eventuality of Ventilation failures of battery room there is possibility of Hydrogen gas accumulation which may get detected.

2. Assumptions & Work Methodologies

- 1) The work shall be carried out through "Engineering, Procurement and Construction" (EPC) Contract.
- 2) Contractor shall submit to Marafiq the following for review and approval before commencing any work.
 - a) HVAC Heat load calculation of battery room.
 - b) Preparation of construction drawing.
 - c) Execution schedule with detailed WBS.
 - d) Method of statement & Impairment plan of Execution each battery room wise.
- MARAFIQ shall identify a suitable area for the Contractor's temporary lay down area, site offices and facilities for the period of construction and commissioning.
- 4) MARAFIQ shall identify the disposal area for the removed partitions and other debris generated during demolition works.

II. TECHNICAL REQUIREMENTS

1. Project Overview

The major element of the work includes but is not limited to the following:

- a. Preparation of Heat load calculations, construction drawings, design criteria, material and work specifications, etc.
 as well as updating the as-built drawings and documents prior to initial work acceptance.
- b. Remove and transfer to specified location of 1.5 Tons Window A/c with accessories from the Battery side of each Battery room.
- c. Providing Cover with Sandwich insulation panel in the removed Window A/c Location. Cover shall be fabricated from 2 mm thick carbon steel sheet, inside and outside the compartment with Painting.
- Remove the Battery room door modify for installation of Motorized damper Explosion proof of each battery room.
- e. The battery room door Motorized damper interfaced with fire alarm, while fire alarm tripping the Motorized damper should be closed.
- f. Make a cut out in Battery side peripheral wall for installing the Motorized damper.
- g. Supply and Installation of 2 Nos of Motorized Damper Explosion proof for each battery room.
- h. The battery room Motorized damper interfaced with fire alarm, while fire alarm tripping the Motorized damper should be Open.
- Design, supply and installation of New Packaged A/c with all accessories in the DC compartment Top battery room.



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- j. Making cut out in top of DC compartment for supply and return air ducting.
- k. Fabrication and erection of Supply and return duct of Each Package A/C system.
- 1. Supply and installation of Supply damper, Diffuser and return Grill of the Each Package A/c system.
- m. Fabrication and Erection of Ladder to access the Packaged A/c system for each DC compartment.
- n. Fabrication and erection of Hand rail for above the Roof of each DC compartment.
- o. Supply and installation suitable switch gear for Packaged A/c.
- p. Modification and the Existing Panel to accommodate the New Switch gear with cabling.
- q. Battery room all Receptacle to be shifted to charger room with new wiring.
- r. Supply and installation of New Explosion proof Ventilation fans 2 nos (1 Working+1 Standby).
- Fabrication and installation of Ventilation inlet Plenum with Velocity sensor Provision.
- t. Supply and installation of Isolation damper for each ventilation fan.
- u. Supply installation of Air velocity monitor with audible alarm into the Ventilation fan inlet plenum.
- v. Supply and installation of Hydrogen gas delector with audible alarm installed in the Battery room Roof.
- w. Supply and installation of Audible System.
- x. Interfacing with Hydrogen gas detector & Air velocity monitor with Audible system.
- y. Painting of damage DC compartment walls affected by installation of Package A/c ,removal of Window A/c and installation of Motorized dampers.

3.1 Design Life

All utilities and buildings shall be designed to keep their structural, operational and aesthetic integrity for a minimum of 30 years.

Electrical installations shall have a minimum design life of 25 years.

3.2 Site Description

The Site is located inside the GTG complex of Marafiq, Yanbu.

3.3 Climatology Data

A. OUTDOOR DESIGN CONDITIONS

Sumr	mer	Winter
Dry Bulb 46	°C (115°F)	Dry Bulb 11°C
Daily Range 14	1°C (25°F)	

B. INDOOR DESIGN CONDITIONS

Chemical Storage Rooms	Offices, Conference room and others
Summer	Summer
Dry Bulb 23°C+/1°C, 50%+/-5% RH	Dry Bulb 24°C+/-1°C, 45-55%RH
	(75°F+/-2°F)
	Winter
	Dry Bulb 22°C

2. Scope of Work

- A. Engineering and design of the HVAC system
 The scope of work shall include the following:
 - a. Design calculations
 - b. Construction drawings
 - c. Construction specifications & work procedure
- B. Supply and installation of the HVAC system
 The scope of work shall include the following:







- a. HVAC equipment and materials including control systems
- b. Shop drawings of equipment and installations
- c. Complete installation of HVAC systems
- d. Provide all work and materials for the complete installation of automatic temperature control System
- e. Complete testing and balancing of HVAC systems
- f. Startup of the HVAC systems
- g. Warranty of HVAC systems after acceptance
- h. Test and inspection reports
- i. Operation and maintenance manuals
- j. As-built drawings
- k. Spare Parts and Special Tools

4.1.1 MECHANICAL WORKS - HVAC

- 1. Designing, supply and Installation of New Packaged A/c system with accessories to each DC compartment.
- 2. Remove and transfer to specified location of 1.5 Tons Window A/c with accessories from the Battery side of each Battery room.
- Making cut out in top of DC compartment for supply and return air ducting.
- 4. Fabrication and erection of Supply and return duct of Each Package A/C system.
- 5. Supply and installation of Supply damper, Diffuser and return Grill of the Each Package A/c system.
- 6. Supply and installation of New Explosion proof Ventilation fans 2 nos (1 Working+1 Standby).
- 7. Fabrication and installation of Ventilation inlet Plenum with SAIL switch Provision.
- 8. Supply and installation of Isolation damper for each ventilation fan.
- Perform the HVAC functional tests, the units shall trip upon detection of smoke inside the DC compartment –
 charger side. Also, the A/c units shall be provided with contacts for connection of interlock to fire detection
 system.

4.1.2 ELECTRICAL WORKS

- 1. Supply and install new cables, conduits, and panel for the proposed air conditioning units.
- 2. Perform sizing calculations for cables, conduits, and circuit breakers based on the new air conditioning units.
- 3. Supply and install electrical disconnect switch for the new air conditioning units.
- 4. Removal of existing window type A/C unit and wiring.
- Fabricate and install mounting brackets/supports for disconnect switch and conduits.
- 6. Supply and install additional conduit and cables for additional ventilation fan and motorized damper. Utilize the existing circuit of ventilation fan on the additional ventilation fan and motorized damper.
- 7. Interface the motorized damper to existing fire detection system.
- 8. Perform insulation resistance test on each additional cables or conductors.
- 9. Perform continuity test on additional control cables.
- 10. Remove the existing receptacles and switches inside the battery room. Install the switches outside the battery room.
- 11. Contractor shall perform all related electrical works necessary for the completion of the project.

4.1.3 MECHANICAL WORKS - GENERAL

- 1. Providing Cover with Sandwich insulation panel in the removed Window A/c Location. Cover shall be fabricated from 2 mm thick carbon steel sheet, inside and outside the compartment with Painting.
- 2. Remove the Battery room door modify for installation of Motorized damper Explosion proof of each battery room.
- Make a cut out in Battery side peripheral wall for installing the Motorized damper.
- Supply and Installation of 2 Nos of Motorized Damper Explosion proof for each battery room.
- 5. Fabrication and Erection of Ladder to access the Packaged A/c system for each DC compartment.
- 6. Fabrication and erection of Hand rail for above the Roof of each DC compartment.
- 7. Supply installation of SAIL Switch / Air velocity monitor with audible alarm into the Ventilation fan inlet plenum.

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- 8. Supply and installation of Hydrogen gas detector with audible alarm installed in the Battery room Roof.
- 9. Supply and installation of Audible System.
- 10. Interfacing with Hydrogen gas detector & Air velocity monitor with Audible system.
- Painting of damage DC compartment walls affected by installation of Package A/c, removal of Window A/c and installation of Motorized dampers.

3. **Technical Specifications**

5.1 HVAC Specifications

5.1.1. HVAC

HVAC duct shall be extended to ensure proper cooling / conditioning requirements for all the office rooms. HVAC duct shall be designed and modified to throw required air to the rooms as shown in arrangement drawing no. 00004-CE-A1-236. Duct shall be designed and provided with Volume damper (VD), Access door (AD), Supply registers, Ceiling return registers.

Duct shall be fabricated and supported through hangers as per spacing listed below:

Ductwork			Hangers		
Metal Gauges Galv Steel	Duct Dimension	Rod dia	Self-Angle	Max spacing	
26	Up to 305 mm		40 x 40 x 3 mm		
24	305-760 mm	9 mm	40 x 40 x 3 mm	2500 mm	
22	760–1070 mm	9 mm	40 x 40 x 3 mm	1800 mm	
20	1070-1370 mm	13 mm	50 x 50 x 5 mm	1200 mm	
18	2135-3050 mm	13 mm	80 x 80 x 6 mm	1200 mm	

The Contractor shall submit detailed work procedures concerning with installation, tie-in, testing and commissioning prior to implementation of the work. The procedures shall indicate clearly if any of existing piping, cable and conduits in the area or its services in the facility will be affected or will require demolishing cut, removal, etc and how it will be rehabilitated or compensated to resume normal operation.

5.1.2. Ductwork

Generally, ductwork shall be designed and manufactured in accordance with the standards set by SMACNA and in accordance with Specification for HVAC. Ducts shall be formed from sheet sleel with hot dip galvanized coating. Average thickness of zinc coating shall be equivalent to not less than 0.6 kg/m2 of zinc for all surfaces.

Duct elements shall be constructed for optimal duct air flow, for example by using baffle plates, turning vanes, reversing blades, etc. so that air turbulence, air borne noise and pressure losses are minimized. Flexible ductwork shall not be used unless necessary, however length is to be minimized (maximum length 1.0m).

Ductwork shall be designed to minimize noise transmission and to avoid noise generation from components or fittings.

Ductwork air velocities shall not exceed the following limits:

Mains 8 m/s Branches 6 m/s

Run-outs 4 m/s





All rectangular 45 to 90 degree elbows in both medium and low pressure ductwork shall contain turning vanes. Radial elbows shall contain splitters Supply and return air ductwork in conditioned spaces shall be insulated. Insulated ductwork up to 2.0m above finish floor level or exposed to outdoor air or in any location subject to physical damage shall be provided with aluminium cladding.

Balancing devices shall be provided at each supply branch connection serving more than one terminal device and each terminal device. Balancing devices shall also be provided at return air ductwork as required to obtain required return airflow.

5.1.3. Duct_Insulation

Faced duct wrap one side with vapor retardant. Foil reinforced kraft (FRK) facing shall have UL fire resistant ratings, flexible blanket insulation composed of fine, stable and uniformly textured inorganic glass fibers bonded together by a bon—water soluble and fire retardant thermosetting resin.

Inside Building : 24 Kg/M3 x 25 mm x FRK facing

Cladding : Aluminum sheets 0.024 "

5.1.4. Dampers

Generally Volume Control Dampers (VCD) shall be provided at all duct branches in order to balance the system and achieve design/required air flow rates. Fire Dampers (FD) shall be fitted in ductwork/air transfer openings as per NFPA 90A, at all firewalls. Fire dampers shall be constructed of galvanized sheet steel. The motorized fire dampers shall be operated form the HVAC control panel. Motorized fire dampers shall be fail safe type (fail to close).

5.1.5. Air Terminals

Terminal devices (outlets) shall be selected based on the following criteria:

- In occupied rooms, the air distribution shall be such that air velocity at 0.9 m/s from floor shall never exceed 0.15 m/s.
- Pressure loss for each outlet on each ductwork branch or run shall be approximately equal to ensure uniform air distribution.
- Supply air grille/diffusers shall be selected for required throw and pressure drop not to exceed
 20 Pa. Return air inlets shall be selected and located based on the following criteria:
- Face velocity across the inlet shall be less than 2.5 m/s.
- Static pressure drop across inlets shall be less than 10 Pa.
- Inlets shall be located at adequate distances from supply devices to prevent short circuiting of supply air.
- Air inlet/return devices should have volume control dampers.

5.1.6. Filters

Access sections with doors shall be provided at each filter section as required for maintenance, filter cleaning and replacement. Filters shall be rated for efficiency of particulate matter removal in accordance with the latest editions of ASHRAE Standard 52 dust spot test.

5.1.6. Miscellaneous materials for HVAC duct installation/tie-in



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Metal screws:	Stainless steel # 8 x 13 mm long	
Tie wire :	Stainless steel	
Fixing pins :	Self-adhesive insulation hanger; self-stick based with locking washer, Dynastic or equal.	
Tape :	pe : Self-adhesive aluminum tape	
Duct sealant :	Fire resistive, fibrated water based, indoor and outdoor vapor barrier sealant for low, medium velocity HVAC ducts. UL listed. Foster or equal.	
Adhesive :	Water based polyvinyl acetate emulsion adhesive. UL listed. Foster or equal.	
Flexible duct connector :	Weather and acid resistant, roof top application, with gauge 24, galvanized steel connector, UL listed. Duro-dyne Durolon or equal.	

- a) The refrigerant shall be "Environmental friendly" such as R-407 or Equal.
- Motorized damper, Explosion Proof, UL listed, as per RC guide Specification # 15840.
- c) Exhaust fan for Explosion & Hazard area, alkali and acid resistant, 115 CFM capacity, 220 V/380V- 3Ph-60 Hz.
- d) Structural steel: Carbon steel ASTM A-36 Galvanized.

5.2. Electrical Material Specifications

5.2.1. Cables

Low voltage cables rated 600/1000V shall be used for installation in conduits and in duct banks below ground. Cables shall be suitable for operation in wet or dry locations with alternately wet and dry conditions. Conductors shall be annealed copper in accordance with IEC 60228. Below grade circuits in duct shall use XLPE or EPR insulated and jacketed cables. All cables used in underground duct banks shall have flame retardant characteristics.

5.2.2. <u>Conduits</u>

Aluminum conduit shall be manufactured standard copper free, seamless tube, aluminum alloy in conformance with ANSI Standard C80-5. Minimum aluminum conduit size shall be 19mm. Coupling, connectors and fitting shall be specifically designed and manufactured to be compatible with conduit, equipment and devices where they are connected. Aluminum conduit shall not be used for underground installation.

Non-metallic conduits for underground installation shall be polyvinyl chloride (PVC), schedule 80, resistant to moisture and chemicals, suitable for underground duct installation, and concrete embedded. For road crossing, concrete shall be provided with reinforcement.

5.2.3. <u>Panel</u>

Bolt-on type panel with rating exceeding the connected loads and available fault current. Totally enclosed panel in a steel cabinet, dead-front type with copper buses, and surface mounted. Panel shall have buses fabricated for bolt-on type circuit breakers. Voltage rating and current rating, number of phases, and number of wires shall be indicated. Ensure panel is rated for 480 volt, three-phase, and 60-hertz. Provide panel with separate grounding bus bonded to the enclosure. Each panel shall have a short-circuit rating equal to or greater as indicated in the panel schedule or electrical drawing. Panel enclosure shall have the manufacturer's standard knockouts. Front shall be of code-gage sheet steel furnished with hinged doors with adjustable trim clamps for securing the front to the box. Panel enclosure shall be rust resistant and NEMA 4X.







5.2.4. Disconnect Switch (non-fusible)

All 3-phase disconnect switches shall be heavy duty type with electrical rating as indicated. Outdoor installation shall require NEMA 4X enclosure. Disconnect switch shall have defeatable door interlocks that prevent the door from opening when the operating handle is in "ON" position. The handle shall be capable of being padlocked in the "OFF" position. Switch operating mechanism shall be non-teasible, positive action, quick make and quick break.

5.2.5. Grounding

Grounding shall be in accordance with Section 16450 and RCEC.

4. Guarantee and Warranty

- a. Vendor shall be fully responsible for all equipment supplied including bought out items. All the equipment shall be fully guaranteed for a period after installation, Commissioning and Provisional Acceptance Certificate. The Vendor shall provide all Certification for the equipment and shall ensure that dimensional compatibility, shaft system critical speeds, vibration, noise levels and acceptability of pipe loads are within the relevant specification limits. Provision of all data necessary for the design of lifting equipment, support and structures is required.
- b. In the event that the equipment is rectified or replaced by the Vendor under the provisions of this article, the guarantee period shall be extended for a period of Twelve (12) months following the satisfactory completion of the rectification or replacement of the equipment.

5. Performance Guarantee

In order to determine compliance of the SYSTEM with the performance requirements set forth in this specification, a performance test shall be carried out for a period of three (3) consecutive days. Should any of the performance tests as described above be deemed unsuccessful, the VENDOR shall, at its own cost, make any and all the modifications required to achieve a successful test.

Once all three performance tests are successful, the PURCHASER shall issue a Final Acceptance letter to the MANUFACTURER

6. Reference Drawings

The following drawings are provided as a separate attachment to this document:

- 1. 331QF29618 Outline of DC Source Compartment.
- 2. 331DF22962 Elementary Diagram.
- 3. 00004-CE-A1-236 DC source compartment.
- 4. 006Q P01-673 One line diagram GTG Unit Substation
- 5. 006Q P01-674 One line diagram of Unit 480V, 120 V /208 V & 125V DC
- AR 10861-EE –A1-001-A Single Line diagram
- 7. AR 10861-EE -A1-002-A Cable Routing Layout







SECTION – IV Q REPLACEMENT OF MCC FOR GTG 1-7







I. GENERAL REQUIREMENTS

1. Project Background

Presently there are 9 x 60MW capacity gas based power generating units that are in operation at MYAS at Yanbu. For supply of power to the unit auxiliaries, 4.16 KV metal-clad switchgear has been installed which supplies power to the 480V switchgear through a transformer and other loads at 4.16KV. One of the 480V switchgear outlet supply power to 480 V MCC panel installed in the auxiliary compartment. This MCC panel supplies power to various generator auxiliaries.

The single line diagram for the system is as per Section 4.0, List of Reference Drawings.

The existing indoor type of Hitachi make 480V MCC switchgear assembly units consist of draw out type cubicles with 600V MCCBs (Terasaki make) of various current ratings. It is required that this existing MCC panel be replaced with new MCC panel with a view to improve the plant reliability.

The existing breakers in the MCC panel do not have the ground fault protection facility. It is required that the new panel will have the breakers having ground fault protection capability.

This replacement of MCC panel is to be carried out for one GTG unit only.

2. Project Purpose

The purpose of this project is to replace Seven (7) unit of the old 480V existing MCC panel with new modern 480V MCC panel with each breaker having the ground fault protection capability.

3. Project Location

The project is for MARAFIQ power and water facility located in Madinat Yanbu Al-Sinaiyah (MYAS

II. TECHNICAL REQUIREMENTS

1. General

This project specification shall apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, supply and install apply to the design, engineering, manufacture, testing, and the design of the design o

2. Brief Work Description

The scope of works under the Contract includes the following:

- Engineering, design, manufacture, testing, supply and installation of the 480V MCC panel for GTG 1 7.
- 2. Removal of the existing 480V MCC panel from the GT MCC auxiliary compartment. Removal of the existing MCC will involve dismantling of the auxiliary compartment, removal of the air conditioning units and again putting it back into the existing condition. Also involved is the disconnection of cables connected to the existing MCC. Crane required for dismantling and erection work shall be provided by Contractor.

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- 3. Handing over the dismantled MCC panel to MARAFIQ at a designated place.
- 4. Termination of all the existing supply cables in the new MCC panels.
- 5. Grounding of the MCC panel with existing grounding grid.
- 6. Re-erection of the auxiliary compartment, air conditioning units to its original condition.

The Contractor shall as part of his full responsibility and scope shall check the ratings of and/or sizes of those components whose ratings or sizes are specified in the Contract document. When this check indicates that the specified ratings or sizes are not adequate, then the Contractor shall make necessary changes at no extra cost to MARAFIQ.

The supply and installation of the 480V MCC panel with all associated accessories shall include the following:

- 1. Manufacturing of major components of the equipment.
- 2. Manufacturing and/or supply of all associated accessories.
- Implementation of Manufacturer's standards and otherwise specified quality control, inspection and testing of products in accordance with applicable standards.
- 4. Sizing and application calculations for system and components and verification of all specified sizes and quantities.
- 5. Preparation of specification and design and shop drawings.
- 6. Preparation of installation data and drawings.
- Preparation of commissioning and start up manuals.
- Preparation of operation and maintenance manuals.
- Testing and certification of specification compliance for all products and test reports.
- 10. Delivery of all materials and equipment to the site including unloading and installation in the prective buildings.
- 11. Special tools required for the initial installation and future maintenance.
- 12. Commissioning spare parts.
- 13. List of recommended operational spare parts.

The installation of the MCC panel and all related equipment and components shall include as minimum the following:

- All works required for delivery, storage and installation of the MCC and related equipment.
- Implementation of all Manufacturers' standards, quality control, inspection and testing procedures.
- 3. Commissioning and energization of the switchgear and related equipment.

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 Preparation of As-Built drawings including revision of existing interface drawings (originals) to as built condition.

Following drawings pertaining to the existing MCC unit are enclosed for reference in Section 4.0, List of Drawings.

006Q-P01-674One Line Diagram of Unit 480V, 120/208V and 125V DC331DF15184Outline of Auxiliary Control Compartment331QF29461Motor Control Center006Q-P01-673One Line Diagram of GT Generator and Unit Substation

The single line diagram of the new MCC is enclosed in Section 4.0, List of Drawings.

3. Applicable Codes and Standards

The switchgear including all components shall be designed and manufactured in accordance with the applicable provisions of the following latest standards except as otherwise herein specified:

- 1. National Electrical Manufacturer's Association (NEMA)
- 2. International Electro Technical Commission (IEC)
- 3. American National Standards Institute (ANSI)

Any conflict between the specification and reference codes and standards shall be brought to MARAFIQ's attention for a written resolution.

4. Material Specification

PRODUCTS

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	<u>Main</u>	<u>Tap</u>
a. Continuous ampere	1200	500A
b. Maximum sym. momentary		
Amperes	42KA,	42KA,
	0.5 Sec	0.5 Sec
c. Material	Copper	Copper
d. Insulation class	2.5KV	2.5KV
	1 min	1 min
e. Ground bus	50v6mm	

Circuit breaker

a. Frame size	100A and other	
b. Interrupting rating, amperes sym.	42KA at 460V	

SPECIFICATION





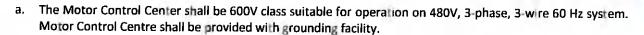
The site conditions under which the Motor Control Center is required to operate are as below:

1. Room temperature, air conditioned (A/C)

25 deg C

2. Room temperature, A/C off

50 deg C



- The Motor Control Center shall be a co-coordinated factory assembled unit, completely wired and ready for connection to power and control cables.
- c. MCC shall be NEMA class enclosure, class II type B wiring 600V class for indoor installation. Short circuit rating of the new bus shall be 42KA. Buses to be braced to withstand maximum total perspective S/C current. The buses shall be copper. Each vertical section shall be provided with a main three phase insulated horizontal bus at the top, and with a three phase insulated vertical bus to distribute power to the combination starters and feeder unit in the vertical section. The main bus and bus taps shall be copper. Bus joints shall have silver to silver contact surface. Bus joints shall have silver to silver contact surface securely bolted to provide low resistance contact. Both vertical and horizontal buses shall be held rigidly within the structure by bus supports fabricated from materials which maintain their physical and dielectric properties indefinitely under the severe conditions.
- d. The Motor Control Center shall have totally enclosed dead front construction arranged in group of vertical section. The vertical structure shall be free standing vertical structure fabricated of rigid steel framework covered with sheet steel and reinforced as necessary. Extensions to either ends should be possible.
- e. Each section shall be equipped with blank steel removable plates, top and bottom to permit drilling or punching of plates for conduit entrance.
- f. Internal bus connections, equipment, materials wiring connection shall be completely accessible from the front of assembly so that mounting against a wall will be possible.
- g. Provide each motor starter with a control transformer as required for secondary voltage of 120V AC. The control transformer and their corresponding fuses are to be mounted in their respective motor starter cubicles. The control transformer secondary shall have one side fused and other side grounded. Pushbuttons, selector switches, overload resets and indicator lights are to be door mounted, protruding through the door. Protrude circuit breaker operating handle through the cubical door and provide with door mounted mechanical operators. Door to the cubical shall not be open unless the circuit breaker is open. With the door open, the interlock shall be provided to prevent the accidental closing of the disconnect. Facilities shall be provided so that authorized personnel may open the door with the disconnect closed, or operate the disconnect when the door is open. Pad locking facility should be provided in the disconnect operating handle to positively lock the disconnect in the off position with the door open or closed. A mechanical position indicator shall be provided to indicate the on, tripped, and off position of the disconnect.
- h. Control relays are to be located in a separate compartment with a hinged door.
- Feeder unit compartments shall be arranged for two molded case circuit breakers, 100A frame minimum, each with a disconnect operating handle on the compartment door.
- Minimum one spare feeder breaker of maximum size shall be available.
- k. A NEMA size 1 starter shall be the minimum size used for motor control.





- I. Space heaters shall be located inside.
- m. Motor starters shall be full voltage combination magnetic type with molded air circuit breaker, shall have three manually reset thermal overload devices and shall be wired for single speed, non-reversing, reversing or multi-speed motors as required.
- n. The combination starter unit and feeder CB shall be selected to safely interrupt the maximum perspective S/C current of the system to which the MCC shall be connected.
- o. Magnetic contactors shall be single throw, shall disconnect all leads to the motor, shall be provided with magnetic blowouts and arc shields, and shall be capable of interrupting 10 times the full load current corresponding to the maximum HP for which they are rated at the service voltage.
- p. Each starter shall be furnished with four extra aux. contact in addition to the contacts used for control and indication circuit.
- q. Extra contacts shall be supplied as two NO and two NC and shall be wired to the terminal blocks.
- r. All combination starter units shall be draw out type. Also the starters shall have door mounted indicating lights. Test facilities shall be provided to enable testing of starter in test position. Each starter unit shall be capable of being easily withdrawn from the structure after disconnecting the power and control leads. It shall not be necessary to unbolt or otherwise work on live parts to withdraw a unit. Units of the same size and rating shall be physically interchangeable. Wiring and terminal block arrangements on each starter or feeder unit shall be identical to other units of the same size.
- Each MCC shall be provided with a main copper ground bus not less than 50x6 mm in cross section running the entire length of control center.
- t. All enclosure parts shall be thoroughly cleaned and given a phosphatizing treatment to inhibit rust and to prime the metal for finish coating. A-2 mil thick electrostatic powder paint coat shall be applied to all surfaces. The paint type and process shall meet UL1332 for electrical equipment steel enclosures. All exterior enclosure covers and doors shall be painted with ANSI 61 grey. For improved interior visibility the interior of the enclosure and plug in units shall be painted white.
- Nameplates as per the standard practice shall be provided on the panels.
- v. Circuit breakers: The breakers shall have molded cases with frame size, number of poles and trip ratings as indicated in the drawings. The circuit breaker mechanism is to be quick make, quick break and entirely trip free. Combination starter breaker shall be equipped with instantaneous magnetic adjustable tripping element only. Feeder unit circuit breaker shall be equipped with both thermal and instantaneous magnetic tripping element. Circuit breakers, fuses and overload heater element shall be temperature compensated for the environment they will be installed. As far as possible use magnetic trip element that is externally adjustable and thermal trip unit interchangeable. Operation of one trip element in any pole shall open all poles of the breaker simultaneously. Interrupting capacity of the 480V breaker shall not be less than 42KA rms symmetrical minimum; unless a higher interrupting rating is shown on the drawing or specified.
- w. All the outgoing feeders of the 480V MCC will have provision to trip the breakers in case of ground fault in the circuit. The facility may be in terms of inbuilt provision in the breaker for ground fault protection or external mounted accessory such as earth leakage CT. Contractor will provide complete details of the hardware provided to achieve the objective of ground fault protection of individual feeders. The size of the new MCC will match with the existing MCC.





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- x. Control wiring shall consist of stranded copper conductor not less than # 14 SWG. Wire insulation class 600V thermosetting and moisture, heat, oil and flame resistant. All equipment shall be completely wired within the control center for control and operation. Wiring requiring external connections shall be brought to terminal blocks for attachment of external leads. Wires shall be terminated with full ring, insulated compression connectors.
- y. Terminal blocks shall be molded composition type with separate terminals for internal and external connections. Terminals shall be screw type and shall be suitable to accommodate a minimum of two nos 12 AWG ring type compression connectors.
- z. Contractor shall match the size of the new MCC with that of the existing MCC. The sequence of order of all the feeders in new MCC shall match with that of the existing MCC so that the cable length is not a problem while re installation. If warranted due to any structural difference with existing MCC, the Contractor shall lay new cable falling short for connection to new MCC. No cable joint will be permitted.
- aa. The control circuit, logics, interlocks and number of auxiliary contacts (NO/NC) of breakers shall be retained as per the existing one.
- bb. Existing alarm circuit will be retained for new MCC. Copy of the alarm circuit is enclosed in Section 4.0, List of Drawings.
- cc. Contractor will foresee the possible obstruction of existing civil, electrical or mechanical structures around the work area and take advance action in consultation with MARAFIQ so that the work of removal of existing MCC and installation of new MCC will go on smoothly.

5. Submittals

- A. Test reports: The Motor Control Center shall have been tested in accordance with applicable standards. Submit test reports for all factory tests and submit certification of type tests or tests to qualify equipment design. Test reports shall show compliance with applicable standards. Also submit field test plans and field test reports.
- B. Design drawings and shop drawings: Submittals of drawings shall include the following as minimum:
 - 1. One line diagram drawings.
 - 2. Outline and arrangement dimensional drawings.
 - 3. Material lists.
 - 4. Layout and installation detail drawing.
 - 5. Schematic diagrams (control schemes)
 - 6. Wiring and interconnection diagrams.
 - 7. Nameplate schedule.
- C. Calculations: Submittal of calculations shall include following as minimum
 - 1. Equipment sizing/application calculations
 - 2. Fault current analysis and protective device coordination studies.
- D. Product data: Submit Manufacturer's catalog material for all equipment furnished.
- E. Samples: Submit color samples for coating and painting finishes.







6. Inspection and Testing

A. FACTORY TESTS:

The 480V MCC unit shall be subjected to routine tests in accordance with applicable standards. Certified test reports shall be provided. Copies of all the test results shall be included in the O&M manuals.

In the event of failure of any equipment to meet the test requirement the Contractor shall obtain MARAFIQ's permission before any repair or modifications are performed. If these repairs or modifications are in MARAFIQ's opinion likely to affect the results of any of the tests previously carried out, an appropriate retesting shall be performed. Retesting, repairs, modifications, and replacements shall be completed within the scheduled time limits for delivery and no additional cost to MARAFIQ.

MARAFIQ reserves the right to witness all the tests. The Contractor shall give eight weeks advance notice for the scheduled test.

At eight weeks prior to scheduled test, the Contractor shall submit to MARAFIQ an outline of the procedure used in performance of tests. This outline shall include a brief description of the test equipment, connection diagrams, proposed test sheets, calculations and maximum and minimum test and performance values which will be used to determine conformance with the specification and applicable standards.

Upon completion of all testing the contractor shall submit four copies of certified report attesting that each test has been performed in accordance with the approved test procedure. The report for each test shall include the date of performance and name of person in charge of the test.

B. <u>TYPE TEST</u>:

Certification shall be provided to show that the type tests were successfully performed on MCC panel identical to those being provided under this Contract.

C. TESTING AFTER INSTALLATION

- 1. Site tests in accordance with the relevant standard shall be carried out by Contractor to ensure that the equipment and materials comply with the specifications and operational requirements. All tests are subject to witnessing by MARAFIQ.
- 2. At eight weeks prior to scheduled test the Contractor shall submit to MARAFIQ an outline of the procedure used in performance of tests. This outline shall include a brief description of the test equipment, connection diagrams, proposed test sheets, calculations and maximum and minimum test and performance values which will be used to determine conformance with the specification and applicable standards.
- 3. Upon completion of the installation and prior to final acceptance each component of each system shall be tested to the complete satisfaction of MARAFIQ. The Contractor shall provide all the test instrumentation, equipment and accessories necessary for demonstration and putting into operation all switchgear parts.
- The test procedure shall contain but not be restricted to the following:
 - Check for completeness.

Checking that all connections and identifications are made in accordance with relevant sch

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- c. Tests to verify the insulation resistance in the electrical main circuit.
- Voltage tests on auxiliary circuits as specified in applicable standards.
- e. Operation tests for the various components including interlocking, local and remote control, local and remote alarm indication, local and remote measuring and metering etc. Current injection as required to verify proper operation of devices.
- f. Functional tests ensuring correct trip and close operation of relays, circuit breakers and local and remote alarm indication.
- g. Functional tests prior to energizing, ensuring correct operation of the entire protection system.
- h. Testing of the high voltage equipments with regards to insulation and phasing.
- High voltage AC tests on switchgear assemblies shall be performed at power frequency test voltage in accordance with IEC standard.

7. List of Reference Drawings

006Q-P01-674	One Line Diagram of Unit 480V, 120/208V and 125V DC
331DF15184	Outline of Auxiliary Control Compartment
331QF29461	Motor Control Center
006Q-P01-673	One Line Diagram of GT Generator and Unit Substation
331DF22962	Alarm Circuit







SECTION - IV R

REPLACEMENT OF GAS FLOW METER & OTHER FIELD INSTRUMENTS FOR GTG UNITS 1-9









I. TECHNICAL REQUIREMENTS

1. General

The scope of work includes the up gradation or replacement of the existing obsolete multi variable transmitter including design verification of existing orifice and configuration, programming of flow calculation and parameters in CSP of SPEED TRONIC system

2. Project Back Ground

Description of existing flow meter system:

Orifice based flow metering system has been designed and installed separately for each GTG. The existing sales gas flow meter of each GTG is designed using multi variable type flow transmitter model 3095 of EMERSON make, which has been discontinued and become obsolete. The multi variable flow transmitter is interfaced to Mark-V using HART tri loop. HART Tri-loop converts a digital multivariable signal into three independent 4-20 mA analog signals. Each GTG has identical flow metering set up installed for energy measurement and recording purpose.

Existing orifice sizing is done for 200"WC DP which is not in compliance with the requirement of SAUDIA ARAMCO Material Specification Standard 34-SAMSS-112. New orifice must meet the requirements of 34-SAMSS-112.

The each GTG has separate metering facility for recording the net inflow (energy) to the respective gas turbine for comparison and checking of net energy flow received from the ARAMCO.

For each GTG unit sales flow measurement is performed downstream side of filter skid for consumption of sales gas. Multi Variable transmitter based Flow meter installed on downstream side of filter skid of each GTG to record the energy consumption of each GTG unit.

The Total energy consumption of facility (GTG 1 to GTG9) shall be the sum of the total energy supplied by ARAMCO. However energy consumed by GTGs is not matching with total inflow of energy received from ARAMCO.

For gas flow measurement that is GTG 1 to 9 as per operation Gas flow measurement is not matching with ARAMCO supplied Gas.

3. Brief Work Description

The Contractor scope shall include the replacement of existing orifice and obsolete multi variable flow transmitter including verification of the design of existing orifice, configuration, programming of flow meter and interfacing and integration of flow meter in the system.

The Contractor scope includes replacement of existing RVDT (Rotary Variable Differential Transformer) of IGV (Inlet Guide Vane), Turning Gear Solenoid (20TG) and LFO clutch solenoid valve (20CF).

4. Detailed Scope of Work Description

The scope of work is EPC which includes detailed engineering design, supply, procurement, installation, testing and commissioning to established satisfactory operation of multi variable flow transmitter for frame 7E GTG units # 1 to 8 and frame 7EA GTG Unit#9. The Contractor shall replace the existing orifice with new

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إِنَّارِ وَالشَّرِّرِ بَانَّ وَالسَّوِدِ PROCUREMENT & CONTRACTS DEPT. orifice. The Contractor's scope includes design, supply, installation and testing of new orifice on fuel gas supply line to each GTG. The multi variable type flow transmitter shall include but not limited to the following:

- 1.1.1 Design Verification, validation of sizing/calculation of new orifice
- 1.1.2 Verification of flow calculation and gas composition parameters configured, programmed in existing control system programming (CSP) of Mark-V of GTG 1-9
- 1.1.3 Upgradation/Replacement of existing EMERSON make model 3095 multivariable flow transmitter with EMERSON, YOKOGAWA or HONEYWELL make SMART type multi variable flow transmitter.
- 1.1.4 Interfacing and integration of upgraded SMART type multi variable flow transmitter to Mark-Vle including configuration, programming of flow calculation and flow parameters in control system programming of Mark-Vle.
- 1.1.5 Replacement of existing RVDT (Rotary Variable Transformer) with state –of-the-art type UL Listed, FM approved LVDT for GTG 1-8. Enclosure of LVDT shall be of NEMA 6P/IP68 protection.
- 1.1.6 Replacement of Turning Gear solenoid and LFO Clutch Solenoid.

5. Technical Requirements:

The contractor shall design orifice as per SAUDI ARAMCO Material Specification 34-SAMSS-112. The new orifice must comply and meet accuracy requirement as per 34-SAMSS-112 and AGA Report-3.

Multi-Variable transmitters (Rosemount 3051SMV or equivalent make) shall be used for orifice, measurement applications for sales gas flow to each GTG. Transmitters shall be direct mounted on the meter run with an integral five valve manifold.

Multi variable transmitter shall have pressure and temperature compensation facility. Multi variable transmitter shall be configured for the proposed gas metering skid as per AGA-3, AGA-5 and AGA-8. Multi variable transmitter shall accept inputs per AGA-3, AGA-5 and AGA-8.

Multi-Variable Transmitters for Static Pressure, Differential Pressure & Temperature shall only be used on orifice run for each GTG.

Multi variable transmitter shall comply with AGA Report-3, AGA Report-5 and AGA Report-8. Multi Variable Flow transmitter shall accept AGA 8 Detail Characterization Method and Gross characterization Method 1 and Method 2 for the Sales Gas Fluid flow configuration in Mark VIe.

6. Applicable Standards:

Following Standards shall be referred for the replacement or up gradation of existing multi variable flow transmitter.

AGA Report#3 Orifice Metering of Natural Gas

AGA Report #5 - Fuel Gas Energy Metering

AGA Report #8 - Compressibility Factor of Natural Gas and Related Hydrocarbon Gases

1.2 Replacement of RVDT with LVDT

The Contractor shall replace existing RVDT with LVDT for position sensing feedback of IGV for frame 7E GTG-18. The Contractor shall do the site survey and gather all the required technical information, drawings which are deemed necessary for upgrading of existing RVDT of IGV with LVDT for monitoring the position feedback of IGV. The Contractor shall provide all attachment and interfacing devices like signal conditioning products.

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power supply etc for adaptability of LVDT while replacing RVDT. The Contractor shall modify the wiring and cabling as required for interfacing of LVDT to SPEEDTRONIC Mark-Vie. The Contractor shall update the configuration in existing CSP (control System Programming) for the LVDT. The Contractor shall design, supply, install, test and commission the LVDT which is designed and manufactured for industrial grade heavy duty gas turbine. Commercial grade LVDT is not acceptable and not allowed.

1.3 Replacement of Turning Gear Solenoid and Fuel Clutch Solenoid

The Contractor shall replace existing turning gear solenoid (20 TG) and fuel clutch solenoid (20CF). Enclosure of turning gear solenoid and fuel clutch solenoid shall be of NEMA 4X, 7.

1.4 Applicable Codes, Standards & Specifications for Orifice Based Gas Flow Meter

The design and fabrication of the metering system shall be in accordance with applicable industry standards and codes of practice referenced below.

API MPMS:

- a) Chapter 1 Vocabulary
- b) Chapter 7 Temperature Determination
- c) Chapter 11 Physical Properties Data
- d) Chapter 12, Section 2 Calculation of Petroleum Quantities

AGA 3 - Orifice Metering of Natural Gas

AGA 5 - Fuel Gas Energy Metering

AGA 8 - Compressibility factors of natural gas and other related hydrocarbon gases.

SAUDI ARAMCO Engineering Procedures and Standards:

SAES-Y-100 Regulated Vendor List for Custody Measurement Equipment

SAES-Y-101 Custody metering of Hydrocarbon gases

SAUDI ARAMCO Material Specification Standards:

34-SAMSS-112 Orifice Meters for Gas Custody Measurement

1.5 Acceptance Criteria of Orifice based Gas Flow meter for Gas Turbine Generators Unit-19

The total uncertainty calculation of the orifice based gas metering system shall be submitted as per the design data prior to the fabrication of skid.

Calculation of orifice custody metering system uncertainty shall be based on the approved design and it shall be within ± 1 % as per API MPMS 14.3.1/AGA3 Part-1. Vendor shall submit the calculation for overall system uncertainty including all components of the metering system.

Approach	Typical total Uncertainty in Quantity Flow Rate Measurement	Standard
Orifice Based Gas Metering System for Gas Turbine Generators Unit 1-9	Less than or equal to ±1.0 %	API MPMS 14.3.1/ AGA 3 Part-1





MARAFIQ PROCUREMENT A CONTRACTS DEPT.

SECTION – IV S REPLACEMENT OF 4.16 KV SWITCHGEAR FOR GTG UNITS # 1, 2, 3,4,6,7 & 8







I. GENERAL REQUIREMENTS

1. Introduction

Power & Water Utility Company for Jubail & Yanbu (MARAFIQ) is a Saudi Joint stock company established by Royal Decree to serve for the utilities requirement in the Industrial City of Jubail and Yanbu.

MARAFIQ is responsible for the operation and maintenance of existing facilities related with power and water utility systems and development, and expansion of these utility systems which comprise of power generation, transmission and distribution, sea water cooling supplies system, desalinated water (potable and process water), production and distribution, sanitary and industrial waste water collection and treatment.

2. Project Background

Presently 8 nos of 60MW capacity gas based power generating units are in operation at MYAS at Yanbu. For supply of power to the unit auxiliaries, 4.16 KV metal clad switchgear has been installed which supplies power to the 480V switchgear through a transformer and other loads at 4.16KV. The single line diagram for the system is as per annexure "A"

The existing outdoor types Hitachi make metal clad switchgear assembly units consist of 4.16KV, 630Amp air circuit breakers (SOLENARC Air CB, type DSE23BN) of make Nissin Electric Co. Japan.

These circuit breakers are in operation for about 22 to 24 years and some of the breakers are giving operational problems. Also since the breakers are obsolete no spares are available. Hence it is required that these existing breakers be replaced with new series of breakers within existing switchgear assembly with a view to improve the plant reliability.

The retrofitting is to be done for 4.16 KV switchgear assembly units of GTG units # 1, 2, 3,4,6,7 & 8.

3. Project Purpose

The purpose of this project is to replace the old 4.16KV breakers within existing switchgear with new modern circuit breakers. Since the breakers will have to be installed in the existing switchgear assembly, all interfacing of the existing breakers with the switchgear assembly will have to be retained.

4. Project Location

The project is for MARAFIQ power and water facility located in Madinat Yanbu Al-Sinaiyah.







II. TECHNICAL REQUIREMENT

General

This project specification shall apply to the supply and installation of new 4.16KV circuit breakers in the existing metal clad switchgear assembly units.

2. Brief Work Description

The scope of works under the contract includes the following.

- 1. Study of the existing 4.16 KV metal clad switchgear assembly with a view to retrofit the existing 4.16KV metal clad switchgear assembly with new advanced series of circuit breakers.
- 2. Removal of the existing 4.16KV air circuit breakers from the switchgear assembly.
- 3. Engineering, design, manufacture, testing, supply of the 630A, 4.16KV circuit breakers.
- 4. Retrofitting of the existing 4.16 KV metal clad switchgear assembly with these new series of circuit breakers.
- 5. Testing the entire 4.16KV metal clad switchgear assembly with the retrofitted circuit breakers.
- 6. Supply of one number "BREAKER-LIFTER" for raking in, raking out, lifting up and down the breaker in the metal clad switchgear assembly

The supply and installation of the circuit breakers of the switchgear with all associated accessories shall include the following.

- 14. Manufacturing of major components of the equipment.
- 15. Manufacturing and/or supply of all associated accessories.
- Implementation of manufacturer's standards and otherwise specified quality control, inspection and testing
 of products in accordance with applicable standards.
- Sizing and application calculations for system and components and verification of all specified sizes and quantities.
- 18. Preparation of specification and design and shop drawings.
- 19. Preparation of installation data and drawings.
- 20. Preparation of commissioning and startup manuals.
- 21. Preparation of operation and maintenance manuals.
- 22. Testing and certification of specification compliance for all product and test reports.
- Delivery of all materials and equipments to the site including unloading and installation in the respective buildings.
- 24. Special tools required for the initial installation and future maintenance.
- 25. Commissioning spare parts.
- 26. List of recommended operational spare parts.

The installation of the circuit breakers and all related equipments and components shall include as a minimum the following.

- 5. All works required for delivery, storage and installation of the switchgear and related equipment.
- 6. Implementation of all manufacturers' standards, quality control, inspection and testing procedures.
- Commissioning and energization of the switchgear and related equipments.
- Preparation of As-Built drawings including revision of existing interface drawings (originals) to as built condition.

The existing 4.16 KV metal clad switchgear assembly units have installed in it, the 4.16 KV 630 Amp draw out type air circuit breakers. The outline general arrangement of the MCS assembly is as per the drawings which are enclosed at attachment A.

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The following as built drawings explain in details the installations, dimensional details, operational details for the 4.16KV metal clad switchgear and the associated draw out type air circuit breakers.

Drawing no	Title
311-3K20612	Outline of 4.16KV metal clad switchgear
311-3K20611	Outline of 4.16KV metal clad switchgear
311-3K20613	Outline of 4.16KV metal clad switchgear
311-3K20614	Outline of 4.16KV metal clad switchgear
311-2J28109	Installation of 4.16KV metal clad switchgear
311-2M05616	Installation of 4.16KV metal clad switchgear
-	Control diagram of air circuit breaker

These draw out type of air circuit breakers are to be replaced with new series of circuit breakers which will fit into the existing space available in the 4.16KV metal clad switchgear assembly.

Contractor is required to design a retrofit solution for installation of new breaker into the existing switchgear assembly in consultation with MARAFIQ. Drawing for the retrofit will be prepared by contractor and will be submitted to MARAFIQ for approval. Also the design calculations for the retrofit will be submitted to MARAFIQ for approval.

Contractor will foresee the possible obstruction of existing civil, electrical or mechanical structures around the work area and take advance action in consultation with MARAFIQ so that the work of removal of existing breakers and retrofitting for new circuit breakers go on smoothly.

While replacing the breakers, care needs to be taken of the fact that the new circuit breakers should be compatible (or should be made compatible with the) with the 4.16 KV metal clad assembly units for the following broad interfacing points.

- 1. The existing stationary disconnect contacts over the switchgear unit should match with those of the new circuit breaker.
- 2. The existing draw out positions of connects, test and disconnect for the existing circuit breakers should match with that of the new circuit breakers.
- 3. The continuity of the existing operating circuit should be maintained with the new circuit breakers installed.
- The operating circuit of the new circuit breakers should be compatible with the available auxiliary dc voltage.
- 5. The existing over current trip devices installed should be interfaced with the new circuit breakers installed.
- 6. Any other hardware available on the metal clad switchgear assembly which is used for racking in and racking out of the circuit breaker in test, connect and disconnect positions should be properly interfaced for the new circuit breakers.

3. Applicable Codes and Standards

The switchgear including all components shall be designed and manufactured in accordance with the following applicable latest standards.

- 1. International electro technical commission (IEC)
- 2. American national standards institute (ANSI)
- Institute of electrical and electronics engineers (IEEE)

Any conflict between the specification and reference codes and standards shall be brought to MARAFIQ attention for a written resolution.

4. Material Specification

1. The circuit breakers shall be horizontal draw out, vacuum type, 3 pole single throw, capable of being racked out from the fully disconnected position, through the test position, to the fully connected position, with the breaker compartment door closed. Guide and racking mechanism shall be adequate to perform this function without the application of undue force and with complete safety. The breakers shall be operated by a possible.

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charged stored energy springs mechanism, charged normally by a universal electric motor and in emergency by a manual handle.

- The three interrupter poles shall be mounted on glass polyester supports. A contact wear gap indicator shall be provided for each interrupter which requires no tools to indicate available contact life and shall be easily visible when the breaker is removed from its compartment.
- 3. Circuit breakers shall be mechanically and electrically trip free.
- 4. Breaker auxiliary contacts on the draw out element and mechanism operated auxiliary switch shall be furnished and wired to terminal blocks. A minimum of four normally open and four normally closed spare auxiliary contacts shall be available in addition to the auxiliary contacts required for breaker operation. Normally closed auxiliary contacts shall break before the normally open contacts are made.
- The circuit breaker mechanism devices shall be wired to terminal blocks for remote control, indication and alarm.
- 6. Circuit breakers shall be provided with control switch with red "closed" and green "open" indicating lights for closing and tripping the breakers in the test and operating positions. Each circuit breaker shall be provided with a visible mechanical indicator connected to the breaker operating mechanism so that the "open", "close", "trip" status is indicated through the front door of the cell. Position indication "operating", "test", "disconnected" shall also be provided.
- 7. Circuit breakers controlled from remote locations shall be provided with a door mounted two position "local" and "remote" selector switch. Remote control shall be prevented when the switch is in "local" position. With the switch in "remote" position open and close control shall be possible only in the operating position. Interlock shall be provided to prevent remote control of the breaker when in the test position. A remote common alarm shall be provided at the local control room and also at the central control building (CCB) to indicate when a control switch has been turned to the local position.
- Discrepancy indication shall be provided at the local control building and CCB for every remote controlled breaker to clearly indicate that the switch is in local position. Indicating lights (red, green) shall be provided.
- 9. When the circuit breaker is open or when the circuit breaker is withdrawn, one or more normally closed breaker auxiliary contacts each in parallel with a cell switch contacts shall close when the breaker is open or withdrawn to switch power to the motor space heater. Each motor space heater circuit shall be provided with a circuit breaker (or fused disconnect switch) for over current protection. A circuit breaker shall be provided in the incoming breaker compartment of each switchgear assembly for controlling the incoming ac supply.
- 10. Circuit breakers shall be electrically operated with stored energy operating mechanisms. Each breaker shall be equipped with a visible indicator mechanically connected to circuit breaker mechanism and located so that the close or trip status of the breaker is indicated through front door of the cell. In addition the breaker shall also be equipped with a position indicator which shows exactly where the breaker is without opening the door. Visual indication (light) shall be provided to indicate that the control circuit is healthy and the breaker is ready to close. Indication shall be provided to indicate the spring charged condition.
- 11. Interlock shall be provided to prevent moving a closed circuit breaker in the cell, to prevent closing of a breaker between operating and test positions, to trip breakers before access can be gained to the racking mechanism upon insertion or removal from the housing. The stored energy mechanism must be discharged when the breaker is moved in the cell. The stored energy spring status shall be indicated "charged" or "discharged". The breaker shall be secured positively in the housing between and including the operating and test positions.
- 12. Each breaker shall be provided with a manual trip push button which mechanically trips the breaker. The manual trip push button and its associated breaker trip linkage shall have no common components with the electrical trip mechanism except the final breaker release device. The push button hall be operable from outside without having to open the door.

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- 13. A two pole circuit breaker shall be furnished in each switchgear assembly for incoming 125V dc control power supplies. The breaker shall be installed preferably in the incoming breaker cubical or auxiliary cubical of the switchgear assembly.
- 14. The operation cycle shall be CO-t"-CO (t"=15 sec). The circuit breaker shall be capable of performing an O-CO cycle when the auxiliary voltage is lost.
- 15. The circuit breaker shall be interlocked with all associated grounding switches to prevent any improper sequence of operation.
- 16. In the event of a protective trip of the circuit breaker means shall be provided to prevent reclosing (antipumping device).
- 17. Operation counters for recording the number of switching operations and a mechanical position indicator shall be incorporated.
- 18. The breaker operating mechanism shall be provided with a latch to block it from operating during maintenance.
- 19. The breaker front panel shall be removable when breaker is withdrawn for use of inspection and maintenance.
- 20. Like parts of the circuit breakers of the same rating shall be fully interchangeable both electrically and mechanically so that where so interchanged, the circuit breakers shall perform equally well in every respect.

5. Technical Specifications

The circuit breakers shall have following significant ratings.

1.	Rated system voltage.		KV rms	4.16	
2.	Current		Α	630	
3.	Maximum system voltage		KV rms	4.76	
4.	Power frequency withstand (1 minute) voltage ri	ms	19		
	Voltage		KV (peal	k)	60
6.	Interrupting current at 4.16KV			ym 40mi	n
7.	Peak withstand current		KA(peak	•	100
8	Short time withstand current three sec		KArms s	ym	40min
9.	Interrupting time		m sec	•	
		as per	ANSI/IEC		
10	. Power system frequency	·	Hz		60
11	. Rated auxillary dc voltage		Vdc		125
12	Power frequency withstand voltage (1 min)				
	For aux. ac voltage		ΚV		2

Name plate details of the existing 4.16KV air circuit breaker (Make: M/S NISSIN ELECTRIC CO. LTD. KYOTO, JAPAN) are as below.

1. Type	DSE 23 BN
2. Standard	: ANSI C 37
3. Rated maximum voltage	: 4.76 KV
4. Rated voltage range factor	: 1.24
5. Rated full wave impulse withstand voltage	: 60KVp
6. Rated current	: 630A
7. Rated short circuit current	: 29KA
8. Rated frequency	: 50/60Hz
9. Rated interrupting time	: 5 cycles
10. Closing control voltage range	: DC 90-130V
11. Tripping control voltage range	: DC 90-130V
12. Motor driving voltage range	: DC 90-130V
13. Closing current	: 4A







6. Submittals

A. Test reports: Submit test reports and certification of tests for manufacturer's factory tests. Test report shall show compliance with applicable standards. Submit field test plan and field test reports.

- B. Design drawings and shop drawings: Submittal of drawings shall include following as minimum.
 - 1. One line diagram
 - 2. Outline and arrangement dimensional drawing
 - 3. Material list
 - 4. Layout and installation detail drawing
 - 5. Schematic diagrams (Control schemes)
 - 6. Wiring diagrams
 - 7. Conduit entry/exit locations

C. Product data: Submit manufacturer's catalog materials for all equipments furnished.



7. Inspection and Testing

A. FACTORY TESTS:

The 4.16KV switchgear equipments shall be subjected to routine tests in accordance with IEC 298 or other applicable standards. Certified test reports shall be provided. Copies of all the test results shall be included in the O&M manuals.

In the event of failure of any equipment to meet the test requirement the contractor shall obtain MARAFIQ permission before any repair or modifications are performed. If these repairs or modifications are in MARAFIQ's opinion likely to affect the results of any of the tests previously carried out appropriate retesting shall be performed. Retesting, repairs, modifications, and replacements shall be completed within the scheduled time limits for delivery and no additional cost to MARAFIQ.

MARAFIQ reserves the right to witness all the tests. The contractor shall give eight weeks advance notice for the scheduled test.

At eight weeks prior to scheduled test the contractor shall submit to MARAFIQ an outline of the procedure used in performance of tests. This outline shall include a brief description of the test equipment, connection diagrams, proposed test sheets, calculations and maximum and minimum test and performance values which will be used to determine conformance with the specification and applicable standards.

B. TYPE TEST:

Certification shall be provided to show that the type tests were successfully performed on breakers identical to those being provided under this contract. Also the parts (involved in 4.16KV circuit) designed for interfacing the new breaker with old switchgear assembly unit will be type tested as per relevant standards.

C. TESTING AFTER INSTALLATION:

- 1. Site tests in accordance with the relevant IEC standard shall be carried out by contractor to ensure that the equipment and materials comply with the specifications and operational requirements. All tests are subject to MARAFIQ witnessing.
- 2. At eight weeks prior to scheduled test the contractor shall submit to MARAFIQ an outline of the procedure used in performance of tests. This outline shall include a brief description of the test equipment, connection diagrams, proposed test sheets, calculations and maximum and minimum test and performance values which will be used to determine conformance with the specification and applicable standards.
- 3. Upon completion of the installation and prior to final acceptance each component of each system shall be tested to the complete satisfaction of MARAFIQ. The contractor shall provide all the test instrumentation, equipment and accessories necessary for demonstration and putting into operation all switchgear parts.
- 4. The test procedure shall contain but not be restricted to the following
 - a.Check for completeness.
 - b.Checking that all connections and identifications are made in accordance with the relevant



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- c. Tests to verify the insulation resistance in the electrical main circuit.
- d. Voltage tests on auxiliary circuits as specified in applicable standards.
- e.Operation tests for the various components including interlocking, local and remote control, local and remote alarm indication, local and remote measuring and metering etc. Current injection as required to verify proper operation of devices.
- f.Functional tests ensuring correct trip and close operation of relays, circuit breakers and local and remote alarm indication.
- g. Functional tests prior to energizing, ensuring correct operation of the entire protection system.
- h.Testing of the high voltage equipments with regards to insulation and phasing.
- i.High voltage AC tests on switchgear assemblies shall be performed at power frequency test voltage in accordance with IEC standard.

8. Reference Drawings

Drawing no.	Title			
311-3K20612	Outline of 4.16KV metal clad switchgear			
311-3K20611	Outline of 4.16KV metal clad switchgear			
311-3K20613	Outline of 4.16KV metal clad switchgear			
311-3K20614	Outline of 4.16KV metal clad switchgear			
311-2J281 0 9	Installation of 4.16KV metal clad switchgear			
311-2M05616	Installation of 4.16KV metal clad switchgear			
-	Control diagram of air circuit breaker			



Bill of quantities

SN	ITEM	UNIT	QUANTITY	RATE	TOTAL
1	Supply and installation of new 4.16KV vacuum circuit breakers in the existing metal clad switchgear assembly including the retrofitting of the metal clad assembly units to suit the fixing of new circuit breakers, testing and commissioning. (as per scope)	Each	5 breakers each for 7 nos. Switchgears		
2	Supply of breaker Lifter	Each	1		



MARAFIQ TE PROCUREMENT & CONTRACTS DEPT.

SECTION - IVT

REPLACEMENT OF
GTGs # 1 & 8 SECONDARY UNIT
AUXILIARY 4.16 / 0.48 KV DRY
TYPE TRANSFORMERS
(2 NOS)







I. GENERAL REQUIREMENTS

1. Introduction

Power & Water Utility Company for Jubail & Yanbu (MARAFIQ) is a Saudi Joint stock company established by Royal Decree to serve for the utilities requirement in the Industrial City of Jubail and Yanbu.

MARAFIQ is responsible for the operation and maintenance of existing facilities related with power and water utility systems. This include development and expansion of these utility systems which comprise of power generation, transmission and distribution, sea water cooling supplies system, desalinated water (potable and process water), production and distribution, sanitary and industrial waste water collection and treatment.

Presently nine (9) GTG units 60 MW capacity each and four (4) of STG units 120 MW capacity each are in operation at MYASPP.

This scope of work shall include the replacement of Gas Turbine Generation Unit Secondary Unit Auxiliary 4.16 / 0.48 k V dry type transformers for 2 Nos. Units (GTGs # 1 & 8) with new equipment in existing enclosure. The project shall be lump sum, turn-key project complete with equipment supply installation, testing and commissioning.

2. Existing equipment description

GTG – auxiliary 480 V electrical bus is supplied from a epoxy mold casting dry type transformer with the following characteristics on nameplate:

Capacity: 1500/2000 k VA AA/ AFA, Three Phase, 60 Hz

Standard ANSI C 57. 12.00

Primary Line voltages; HV- 4160 V +/- 2.5 % Taps, Delta connection

Secondary Line voltages: LV 480 V, Connection Y grounded

Temperature rise: 90 Deg. C Impedance: 7.4%, at 110 Deg. C

BIL 25 k V

A dial thermometer with temperature probe, contacts, is provided for winding temperature to control Air cooling fans

The existing transformer is housed in Metal Clad switchgear, cubicle # 3 (outdoor type), but installed in indoor area of Gas Turbine Building. The Gas Turbine Building is not Air Conditioned and is subject to 50 deg. C ambient and humidity as main large doors can be open. The enclosure is not provided with ventilation slots on the top and bottom.

The transformer switchgear enclosure contain also the 600/5 A grounding CT, Over current protection relay (51N) 5A, 60 Hz, transformer cooling fans, high voltage cable connections, supports insulators and 2,500 A-LV Bus bar connections to existing LV Switchgear. Six Air Conditioning units with approximate capacity of 17,000 BTU are provided to control ambient transformer housing temperature. For details of existing equipment see drawing listed in next paragraph. Additional drawing can be consulted upon request, at plant library.

3. Reference drawings:

1. Outline of 4.16 k V – 1500 / 2000 k VA dry type transformer cubic

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- 2. Existing installation of 4.16 k V and 600 V Metal Clad Switchgear
- 3. Partial One line diagram of Secondary Unit Auxiliary Transformer.
- 4. Existing transformer name plate information

1.2 Local environmental conditions

The existing facilities are located at less than 1000 feet from sea shore with following climatic conditions:

Outdoor air temperature:

a. Range of monthly maximum: 35.1 to 60 Deg.C

b. Range of monthly minimum: 6.0 t to 12.0 Deg.C

c. Range of monthly mean daily maximum: 25.5 to 35.9 Deg.C

d. Range of monthly mean daily minimum: 12.3 to 26 Deg.C

e. Relative humidity:

Maximum relative humidity 100 %

Minimum relative humidity 6 %

The area is subjected to sand storms and corrosive atmosphere

GTG building is not air conditioned, the large doors can be open and indoor area where the existing enclosure is located is subject to dump and corrosive atmosphere.

Design ambient temperature shall be 50 Deg. C Max, Average 40 Deg C.

For other indoor areas subject to air conditioning system the following are the ambient conditions:

Room temperature, air-conditioned : 32 deg C

Room temperature in A/C fails (8 hours) : 55 deg C Humidity without A/C : 90 %







II. TECHNICAL REQUIREMENT

1. Summary description of work:

The CONTRACTOR scope of works shall consist as a minimum:

- a. Manufacture and supply of a standard epoxy mold, dry type transformer to be installed in existing Metal Clad Enclosure described in paragraph 1.2. Transformer terminals shall match existing field High voltage cable and Low voltage buses connections. It is CONTRACTOR's responsibility to provide the existing bus bar, flex connection, dimensions and characteristics to transformer manufacture for terminals design.
- **b.** Removal of old transformers from Metal Clad enclosure and installation of new Transformer in the same enclosure using building overhead crane.
- c. Provide connections of HV and LV terminals to existing 4.16 k V cable and 480 V bus bars.
- d. Reconnection of all low voltage cables, control circuits, LV bus duct and buses to new transformer. All control wires for power supply, protection and alarms to the existing equipment shall be reconnected and tested for proper functioning.
- e. Field testing for reinstalled Dry type transformer, auxiliaries, transformer protection and ground fault relay.
- f. Field operational testing and commissioning of new transformer.
- g. Shifting of the old transformers to Marafiq'ss designated warehouse.

2. Detailed Scope of Work

3.1 General

The work shall consist of engineering, design, manufacture, testing of a dry type transformer similar to existing equipment and installation in existing cubicle nr. 3 outlined in drawings listed in Section 1.2. The supply of equipment by CONTRACTOR shall include as a minimum, the following:

- Manufacturing of major components and all accessories in accordance with manufacturer standards, quality control, and inspection and testing.
- Sizing and application calculations for all components
- Factory testing reports and certificates for all components
- Preparation of installation data and shop drawings
- Verify the existing relay protection system suitability for all new and modified system. Recommend and implement any necessary changes including new equipment installation.
- Preparation and commissioning and start-up manuals.
- Preparation of operation and maintenance manuals.

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- Delivery of all materials and equipment at site
- Supply special tools required for installation and future maintenance
- · Equipment installation, field testing including existing protections and commissioning
- Commissioning spare parts
- List of recommended operational spare parts.
- Preparation of "As built "drawings including revision of existing drawings to as built condition.

3. Codes and standards

The electrical equipment and materials shall be designed, manufactured, tested and installed in accordance with the latest issues of following international applicable standards. Internationally accepted standards of manufacturer country may be approved for use provided that they are equivalent:

IEEE/ ANSI C57.12.55. Dry type Transformers used in Unit Installation including Unit Substations

IEEE /ANSI 142

Recommended practice for grounding of Industrial and commercial power systems.

RCEC

Royal Commission Electrical Code

NEC/ NFPA 70

National Electrical Code

NFPA

National Fire Protection Association

ASTM

American Society for Testing and Materials

NEMA

National Electric Manufacturer Association

UL

Underwriters Laboratories Inc.

Any conflict between the specification and reference codes and standards shall be brought to MARAFIQ attention for a resolution.

4. Equipment Specifications

3.3.1 Dry type transformer

The dry type transformer shall be manufacturer proven design, epoxy mold type, cooper windings, with capacity for self-cooled (AA) and forced cooled (AFA). Technical data shall be similar to those shown in Section 1.2 of this Scope of work and attached existing transformer name plate sheet. High and low voltage terminals shall be designed to match existing buses. The transformer shall be a high efficiency within industry standards recommendation and manufacturer shall ensure that the transformer can be installed and operate inside of the existing enclosure with life expectancy recommended by industry standards. Winding material insulation temperature rating shall be higher than maximum temperature rise over ambient temperature as recommended by IEEE standards. It shall be of a proven design, designed and manufactured in accordance with applicable ANSI / IEEE or IEC standards for all components and related auxiliary equipment. Vibration noise level shall be according to standards requirement.



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High voltage line terminals and Low voltage Line terminals and transformer windings shall have insulation level as recommended by C57.12.51 standard for specified voltage.

Name plate showing transformer rating shall be in accordance with applicable standards. Information shall include as a minimum k VA ratings (AA/AFA) with corresponding temperature rises above ambient, nominal voltages, voltage taps, percent impedance on kVA base, winding connections, weight, serial number, year of manufacture, manufacture name and address. Name plate shall be non-corrosive metal and information shall be stenciled to provide permanent readability. Name plate shall be written in English. All auxiliary equipment such as dial type thermometer for cooling fan control with alarm contact, cooling fans including control unit, shall be provided. Cooling control panel shall be complete with contactors, protection, indicating lights and power supply which may be from transformer low voltage buses. The transformer shall have provision for lifting and jacking to facilitate installation on existing enclosure.

3.3.2 Factory test and reports

Certified routine factory test reports for this equipment shall be provided by CONTRACTOR in accordance with manufacturer standards. Copies of all the test results shall be included in the O&M manuals.

Certification shall be provided to show that the some required typical UL or other tests were successfully performed on equipment identical to those being provided under this contract.

5. Equipment installation

4.1 General

CONTRACTOR shall remove the old transformer and install new one using, with MARAFIQ approval, lifting overhead facilities for heavy equipment available in GTG turbine hall. CONTRACTOR shall be responsible for providing lifting overhead crane operator and manipulators during equipment installation. Lifting devices and other necessary equipment of adequate capacity to fit the equipment size and weight shall be provided. All work shall be performed by qualified and properly trained personnel. If any surrounding obstructing equipment or structural beam is necessary to be removed, with providing temporary supports or other structural members, CONTRACTOR shall obtain permission from MARAFIQ. If necessary temporary supports or other structural members the CONTRACTOR shall provide drawings with details. Any removed element shall be fixed in original position, provided that any existing rust / corrosion in joining plates are removed and corroded or damaged bolts and nuts replaced with new ones of same material designation.

4.2 Removal of transformer and installation of new dry type transformer in existing enclosure.

The old transformers shall be removed and new transformer installed in existing enclosure using transformer track wheels and building overhead crane.

The new transformer shall be proper anchored to existing enclosure floor to prevent movement due to vibration. Equipment shall be installed per manufacturer recommendation, practices and applicable standards.

CONTRACTOR shall be responsible for installation and reconnection of all high voltage cable and low voltage bus bars to transformer terminals. The transformer terminals and flex connections designed by manufacturer shall match field buses. All other cables, power supply, control wires and grounding cables to plant ground system shall be connected. CONTACTOR shall be responsible for the completeness of erected equipment and shall test, verify for proper operation of all components, assembles, subassemblies, control and auxiliary devices such as:

Dry type Transformer

8.2 V

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Cooling fan control unit, temperature probe and thermometer Existing transformer 50/51 and Neutral ground fault protection relay (51N), Space heaters, thermostat control

Ac units operation

Where required, labels for danger, caution, and warning and for special or nonstandard instructions shall be provided. These warning, danger labels shall be inscribed both in English and Arabic, using red letters on white background.

The old transformers shall be transported to MARAFIQ's designated ware-house.

5. Testing and Commissioning:

The field tests of the installed equipment performed by CONTRACTOR shall include, but is not limited to the following:

- 5.1 Site tests in accordance with the relevant IEC or IEEE standards shall be carried out by CONTRACTOR to ensure that the equipment and materials comply with the specifications and operational requirements. Perform tests and checks in accordance with approved test procedures and criteria provided in advance by manufacturer for every equipment installed in this project. Tests shall be conducted by CONTRACTOR, subject to MARAFIQ witnessing.
- 5.2 At eight (8) weeks prior to scheduled test the CONTRACTOR shall submit to MARAFIQ an outline of the procedure used in performance of tests. This outline shall include a brief description of the test equipment, connection diagrams, proposed test sheets, calculations and maximum and minimum test and performance values which will be used to determine conformance with the specification and applicable standards.
- 5.3 Submit certified reports attesting that each test was performed in accordance with approved test procedures. The test report for each equipment shall include the date of performance and name of the person in charge of the test. The CONTRACTOR shall provide any remedial work, spare parts, as a result from the test and before warranty period expire, if necessary for the installed equipment to perform in accordance with Specifications.
- 5.4 Operation and Maintenance manuals shall be prepared after equipment installation and testing. The manuals shall be complete with all equipment characteristics, factory information, drawings, testing certificates, maintenance procedures, calibration / testing procedures, and as build drawings. Three hard copies and two in electronic form (CD) shall be provided.







SECTION - IV U

GTG PERFORMANCE TEST AND TRAINING





I. GENERAL REQUIREMENTS

1. Introduction

MARAFIQ is a Power & Water Utility Company for Jubail and Yanbu with its head office located at Jubail. MARAFIQ supplies power, potable water, seawater for cooling, wastewater treatment and management systems to the industrial customers in the cities of Jubail and Yanbu. MARAFIQ was formed by Royal Decree No. M/29 as a Private Stock Utility Company serving Jubail and Yanbu Industrial Cities.

MARAFIQ is owned by:

Saudi Arabian Oll Company (Saudi Aramco)
Saudi Basic Industries Corporation (SABIC)
The Royal Commission for Jubail and Yanbu (RC)
The Public Investment Fund (PIF)
Seven (7) Saudi Private Companies

Power and Water Utility Company for Jubail and Yanbu (MARAFIQ) has facilities located in Jubail and Yanbu. Facilities in Yanbu are the Power, Desalination and Seawater Cooling Complex which is referred as PD&SC hereinafter referred to as MYAS.

2. Project Purpose

The purpose of this project is to conduct performance Test for Gas Turbine frame 7E No.1 - 8 with and without HRSG.

Also to provide On/Off Site Performance Training as specified in item # 6.

The offsite Training Course shall be given before the onsite Performance Test to make Marafiq Staff aware about the methodology of conducting the performance test.

All training costs and expenses, training materials, manuals, and use of training facilities costs shall be borne by Contractor.

3. Project Location

The proposed project is located within the PD&SC Complex at the HIP Area in Industrial City of Yanbu.

4. Scope Of Work and contractor responsibility

The Contractor is required to verify performance of the gas turbine and compressor at Base and Peak Load on the Primary and Secondary Fuel used by Marafiq Company for GTG Unit No. 1 – 8.

The field test should provide a baseline for the gas turbine and compressor at the site of delivery to compare to the factory performance test; although the field tests accuracy may be inherently lower. In addition, the field performance test is the final validation from the manufacturer to Marafiq of the guaranteed performance.

Marafiq needs to verify performance of the gas turb ne and compressor.

The baseline test can be used for comparing and monitoring the health of the gas turbine-driven compressor package in the future.

The user or manufacturer needs to assess performance of the gas turbine or compressor because of degradation concerns unit aging.

Based on the field test results, a performance recovery program may be initiated.

The user requires calibration of an installed historical trend monitoring system. The field

The following guideline is a suggested for field testing of gas turbines and centrifugal compressors.

Specific considerations at a field site may require deviation from this guideline in order to meet safety requirements and

improve efficiency, or comply with station operating philosophy.

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اوارة الشتريات والمقود PROCUREMENT & CONTRACTS DEPT. The following guideline is intended to serve as a reference for field testing of gas turbine and centrifugal compressor performance. This guideline applies to any party conducting a field test of a gas turbine or centrifugal compressor (manufacturer, User Company, or third-party). It is intended to provide the most technically sound, yet practical procedure for all aspects of conducting field performance tests of gas turbines and centrifugal compressors.

The conditions at the field site often cannot be as closely controlled as in a factory environment. The specific site conditions of a particular test may dictate that the test procedure deviates from this guideline or the ideal installation described. This does not preclude a field site test. Nonetheless, when a particular test deviates from the installation requirements or other test procedures, the deviation will affect the test uncertainty and should be accounted for in the uncertainty analysis, as recommended in this guideline.

The standards that are used as references for this guideline are ASME PTC 10-1997, "Performance Test Code on Compressors and Exhausters," ASME PTC 22-1997, "Performance Test Code on Gas Turbines," ISO 2314, "Gas Turbine Acceptance Tests," and ISO 5389, "Turbo compressors — Performance Test Code."

5. Performance Parameters

The following seven performance parameters generally describe the performance of a gas turbine and centrifugal compressor. These parameters are commonly used in acceptance testing, testing to determine degradation of the machine, and operational range testing. The primary measurements required in order to calculate these parameters as the following: -

- 1. Centrifugal/Axial Compressor Flow/Flow Coefficient
- 2. Centrifugal/Axial Compressor Head/Head Coefficient
- 3. Centrifugal/Axial Compressor Efficiency
- Centrifugal/Axial Compressor Power Absorbed
- 5. Gas Turbine Full Load Output Power
- 6. Gas Turbine Heat Rate (thermal efficiency)
- 7. Gas Turbine Exhaust Heat Rate
- 8. Determination of Surge Point and Turndown

The following test data must be measured to determine the above performance parameters: -

Centrifugal/Axial Compressor Test Measurements:

- Suction Temperature
- Suction Pressure
- Discharge Temperature
- Discharge Pressure
- Flow Through Compressor (Pressure, temperature also required at the flow measurement point)
- Suction or Discharge Gas Composition
- Barometric Pressure
- Speed of Rotation
- Impeller Diameter
- Upstream and downstream piping arrangement
- Pipe Diameter (upstream and downstream)

Gas Turbine Test Measurements:

- Engine Inlet and Ambient Temperature
- Barometric Pressure
- Power Turbine Speed
- Gas Generator Speed
- Fuel Flow (Pressure, temperature also required at flow measurement point for fuel gas)
- Fuel Gas Composition
- Inlet and Exhaust Pressure Loss



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- · Relative Humidity of Inlet Air
- Water Injection Rate

Marafiq requesting the bidders to provide a Compressor/ Turbine field testing procedure that reduces measurement inaccuracies and maintains cost efficiency also to provide the Marafiq by planning and organization of field tests, necessary instrumentation, data reduction, data correction, test uncertainty, the interpretation of test data and applicable test codes and their relevance for field testing.

Marafiq and contractor should agree upon document the parameters of interest for the test, as well as the criteria (minimums and maximums) for acceptance. Gas turbine power and fuel flow, and gas compressor efficiency generally are the primary parameters, while compressor flow range and surge margins are examples of other common performance parameters.

In a very early stage of the project, discussions should be started about necessary instrumentation and the site preparation to allow for the installation of the required test instrumentation, such as flow metering runs, thermo wells, and pressure taps. Inevitable shutdowns and the effect of the test on production need to be addressed. In this phase, the tradeoff between various options of installing instrumentation and the effect on conducting the test can be evaluated.

The Performance test Codes shall be followed and not limited below

ASME Power Test Code 22 (1 997)

ASME PTC 22 is, in its concept, written for factory tests. It defines acceptable instrumentation and instrumentation accuracies for all necessary test data. For every site performance test, it needs to be discussed whether the situation onsite allows for the stipulated test methods and accuracies.

PTC 22 acknowledges the fact that correcting engine data is only possible using manufacturers' curves or equivalent. They also acknowledge the fact that the correct setting of the control temperature (or the inability to do so without accurate airflow measurement) contributes significantly to the test uncertainties for the engine power.

The test uncertainty calculation is per ASME PTC 19, which, from a theoretical standpoint, is a correct implementation of the statistical basis of uncertainty calculation.

It needs to be decided on a case by case basis whether the instrument accuracies are always practical for a field performance test. As mentioned previously, increasing the accuracy of the fuel flow measurements to the PTC 22 requirements only makes sense if other measurements, such as power, can be performed with about

the same level of accuracy. Otherwise, the added cost will not significantly improve the test results for thermal efficiency. The acceptable variations in measured data during a test run (i.e., during a stable test point) may lead to added uncertainties in the heat rate if totalized fuel flow measurements are used.

Note that ASME PTC 22 was revised only recently (1997). The previous code had, for example, more stringent requirements for fuel flow accuracy on gas fuel, which were almost impossible to meet in the field.

ISO 2314 Gas Turbines-Acceptance Tests (1993)

This code applies to both factory and site tests. It states clearly that machines have to be cleaned, if necessary, and also emphasizes requirement for steady-state operating conditions. The allowable variations in test conditions during the test are somewhat different from PTC 22 (ISO 2314 allows one percent variation in barometric pressure, 2°C variation in ambient temperature, and two percent

variation in LHV, PTC 22 allows 0.5 percent, 2.2·c, and one percent, respectively). The authors think that given the possible speed of data recording, and the fact that 2 " C variation in

temperature can cause two percent variation in power; the limits for temperature variation should be set to 1 "C. Since the code is written to encompass a wide variety of applications, some of the required measurements (for example, exhaust temperature) can be waived, depending on what the test is supposed to prove. B oth ISO

2314 and PTC 22 are very close in the requirements for fuel flow measurement accuracy lone percent and 0.9 percent, respectively) for gas fuel.

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The accuracy requirement for exhaust temperature measurement of 3°c is not easily met in the field. Neither are the requirements for measuring the turbine exit pressure. The code neglects the difference between ambient temperature and compressor inlet temperature to some degree. It also does not acknowledge the effect of relative humidity on engine performance. ISO 2314 also, neglects the problem of determining the correct control temperature in the field as a source of uncertainty.

The data correction procedures in ISO 2314, using a similarity approach for gas turbines, are not practical (this has been discussed in the section "Similarity Conditions for Gas Turbines"). A particular problem is that this specification gives no guidelines regarding test uncertainty calculations. ISO 2314 mandates taking power requirements for separately driven auxiliary equipment (such as electric motor driven lube oil pumps) into account.

ISO 2314 also seems to encourage the use of torque meters for measuring the shaft power, which may not always be practical, especially for smaller turbines. The calibration procedure (against a dynamometer) only seems to be practical in a factory test environment.

ISO 2314 also describes the method of using a heat balance over the gas turbine (Equation 5).

ASME Power Test Code 10 (1997)

ASME PTC 10 has recently been revised. In its concept, it is more suitable for factory tests than site tests. The code distinguishes two types of tests. 'Type 1 requires testing with the specified gas and at or near the specified operating conditions.

Type 2 tests allow substitutes such as nitrogen, carbon dioxide, and others. The PTC 10 refers to ASME PTC 19 for test uncertainty analysis. While the general accuracy and the amount of instrumentation as required in PTC 10 can be met in field performance tests, some added thoughts seem to be in order:

Data correction-PTe 10 assumes that the test is conducted close to the specified conditions. This may not be possible at a site test.

Instrumentation-In many cases, the situation at site does not allow meeting PTC 10 requirements. Often, the amount of instrumentation will be less than required by the code, or the instrument locations have to be adjusted to the site requirements. This does not preclude conducting a valid field performance test, but has to be considered in a test uncertainty analysis.

Real gas behavior-ASME PTC 10 does not specify an accurate method for calculating real gas properties. The specified method calculates a poly tropic head rise based on an approximation equation that does not provide the same accuracy as modern equations of state.

Performance Test Training

A. General

The work of this part shall be for providing necessary factory Training of MARAFIQ in order to operate, maintain the system and equipment and able to conducting performance test installed under this project successfully. The Contractor shall provide the off / onsite Training course, Training material, training aids, and qualified instructors ahead of the unit performance test by one month at least.

Three months prior to facility start up the Contractor shall submit for MARAFIQ review and approval:

- a) List of course
- b) Course outline
- c) Course material
- d) Schedule
- e) Instructor(s) name and qualification

B. Course Material

- a. Course material shall be assembled in ring binders.
- For OFF/ON Site Training course, three (03) sets of hard/soft copies course material shall be provided.
- c. Each set of course material shall contain in addition to the required material, the original printed document for technical bulletins, instruction pamphlets, and catalog material and transaction documents for professional organization.

ROCUREMENT 4



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C. Course Description

This Training course shall be designed to provide basics and advanced training of Gas Turbine Performance Course Content the candidates at least as the following:

1. Gas Turbine General Description

- Axial compressor
- Combustion system
- Turbine section

2. Auxiliary systems overview

3. Theory of operation

- Thermodynamic parameters
- Specific compression work
- Specific expansion work
- Useful power
- Heat rate
- Efficiency
- Brayton cycle: ideal and real cases

4. Gas Turbine performance

- Performance curves
- Parameters affecting performance
- Ambient temperature
- Ambient pressure
- Relative humidity
- Inlet pressure drop
- Exhaust pressure drop
- Back work ratio
- Specific Fuel consumption
- Combustion efficiency

5. Performance test: procedures and main parameters involved

- ASME PTC 22
- Classroom test: example of calculation

6. Evaluation methods for performance deterioration

- Axial compressor efficiency: evaluation & monitoring procedures
- Inlet filter fouling: evaluation & monitoring procedures
- Combustion system failure: evaluation & monitoring procedures
- Form of reporting the performance test result



In addition to the theoretical Training, real life case studies should be presented by the instructors to enhance the trainees' skills in Performance Test Evaluation and troubleshooting gas turbine and gas compressor issues. Acquiring and perfecting these skills will enable them to go back to the workplace and perform their job with a much higher level of performance and accuracy.

Also, should be an opportunity for hands-on learning during the performance Test at Field.

Contractor shall provide training for MARAFIQ Candidates. Both on-site and off-site training ahead of the units performance test and level of training shall be suitable for the staff to ensure individual competence in

7. Reliability test:

The Reliability Test will be carried out without failure or interruption for a continuous 30 days period







(One month) as specified in the RFP.

The Reliability Test will be after plant Performance Tests. Contract should include a part for Reliability Test Procedure, Recording and Reporting Reliability Test Results and Monitoring the Reliability Test.

Marafiq shell review the report and within (14) working days or two (2) weeks, Marafiq shall inform the contractor whether the test is successful and accepted.







ECTION – IV V TRAINING TO MARAFIQ STAFF









a) Contractor shall provide training for MARAFIQ Candidates. Both on-site and off-site training is required. Separate training sessions shall be conducted for each of all equipment supplied under the contract and level of training shall be suitable for each member of staff to ensure individual competence in operation, maintenance, troubleshooting, administration & management. Training shall be provided for both system operation and maintenance of equipment. Course material, training aids, schedules and qualified instructors shall be provided by Contractor.

All training costs and expenses, training materials, manuals, and use of training facilities costs shall be borne by Contractor.

b) Contractor shall provide training services for the system as detailed below:

Training Subject	On-Site Tealning		Off-site Training	
	Duration	No. of Trainees	Duration	No. of trainees
GTG Operation for Upgraded, Replaced Parts like performance of GTG Radiator(Cooling Water Module) calculation, and Sales Gas Flow meter and field instrumentations	5 Day	5	5 Day	5
Water Injection Training	5Day	5	5Day	5
Upgraded Hardware Mark VIe Control Systems and Excitation Systems	5 Day	5	5 Day	5
CIMPLICITY HMI Training	5 Day	5	5 Day	5
TOOLBOX ST Engineering	5 Day	5	5 Day	5
	GTG Operation for Upgraded, Replaced Parts like performance of GTG Radiator(Cooling Water Module) calculation, and Sales Gas Flow meter and field instrumentations Water Injection Training Upgraded Hardware Mark VIe Control Systems and Excitation Systems CIMPLICITY HMI Training	GTG Operation for Upgraded, Replaced Parts like performance of GTG Radiator(Cooling Water Module) calculation , and Sales Gas Flow meter and field instrumentations Water Injection Training Upgraded Hardware Mark VIe Control Systems 5 Day and Excitation Systems CIMPLICITY HMI Training 5 Day	GTG Operation for Upgraded, Replaced Parts like performance of GTG Radiator(Cooling Water Module) calculation, and Sales Gas Flow meter and field instrumentations Water Injection Training Upgraded Hardware Mark VIe Control Systems and Excitation Systems CIMPLICITY HMI Training Duration No. of Trainees 5 Day 5 Upgraded Hardware Sales Gas Flow meter and field instrumentations 5 Day 6 Day 6 Day 6 Day 6 Day 6 Day 7 Day 7 Day 7 Day 8	GTG Operation for Upgraded, Replaced Parts like performance of GTG Radiator(Cooling Water Module) calculation, and Sales Gas Flow meter and field instrumentations Water Injection Training Upgraded Hardware Mark VIe Control Systems and Excitation Systems CIMPLICITY HMI Training Duration No. of Traines 5 Day 5 Day

- Contractor shall submit the following items for off-site / on-site training programs to the MARAFIQ for review and approval.
 - a. List of courses
 - b. Course outline for each course
 - c. Pre-requisites and qualifications of trainees for each course
 - d. Course material for each course
 - e. Schedule for courses
 - f. Instructor(s) names and qualifications for each course
 - g. Location for each course

e) Course curriculum and instructor(s) shall be approved at least 30 days before commencement of a course. Training shall be conducted by qualified & competent personnel who are thoroughly knowledgeable with the theory, operation and maintenance of the new parts like turbine rotor, compressor rotor, GTG breaker, electrical equipment and instrumentation.





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e) Course material shall be assembled in 4-ring binders.

For on-site training, a minimum of five 5 sets of course material shall be provided for each on-site course.

Formal classroom training supported by audio & video aid and to larger extent practical "hands on" exercises with the equipment supplied under the contract shall be part of the training. Each set of course material shall contain in addition to the required material, the original printed documents for technical bulletins, instruction pamphlets, material catalog and transaction documents from professional organizations.







KINGDOM OF SAUDI ARABIA POWER & WATER UTILITY COMPANY FOR JUBAIL & YANBU (MARAFIQ)



ATTACHMENT "E" HSE AND FIRE PREVENTION MANAGEMENT PLAN

Contract PO No. 7200026909

GAS TURBINE GENERATORS REHABILITATION BY REPLACEMENT OF THE MAJOR PARTS – YANBU







POWER & WATER UTILITY COMPANY FOR JUBAIL & YANBU (MARAFIQ)

HSE & FIRE PREVENTION MANAGEMENT PLAN

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HSE & FIRE PREVENTION MANAGEMENT PLAN

1.0 HEALTH, SAFETY AND ENVIRONMENT (HSE) OBJECTIVES

To manage and carry out all activities associated with the project until completion of the following main objectives:

- ZERO (0) Injuries and ZERO Fires
- ZERO (0) Reported cases of ill health
- ZERO (0) Property & Environmental Damage
- Disposal of wastes in accordance with the company (MARAFIQ) procedures

These objectives are achieved through:

- a) Establishment of a high level of awareness and discipline.
- b) Identification of areas of high risks and carry out risk assessments.
- c) Provision of information, instruction, training and supervision of contractor personnel with respect to method of statements, Permit to Work and other safety requirements to control risks associated with the nature of contractor's works.
- d) Promotion of a positive approach to health, safety and environment.
- e) Monitoring the effectiveness of the management systems of Health, Safety and Environment performance by conducting regular scheduled audits/inspections and tracking of incidents.

2.0 RESPONSIBILITIES

2.1 CONTRACTOR PROJECT GENERAL MANAGER

Contractor Project General Manager has overall and ultimate responsibility for all matters relating to Health, Safety and Environment. He will be responsible for full compliance with the contract requirements with regard to the Health, Safety and Environment by their respective companies. He shall ensure that HSE & fire prevention management plan & annual safety action plan are in place and are monitored and reviewed for effectiveness. He shall ensure compliance with Clause # 22 of MARAFIQ safety manual. He shall provide status of HSE performance every month to MARAFIQ Safety section through MARAFIQ coordinating department, and provide HSE officer for managing and advising safety on site and coordinating with MARAFIQ Safety section. Number of safety officers and / or safety manager required shall depend on the nature of contract work, risks and number of employees and shall be appointed by the contractor in consultation with MARAFIQ Projects Department and MARAFIQ Safety section and shall be specified in Safety Plan.

2.2 CONTRACTOR PROJECT SUPERVISORS

Directly responsible for cascading and implementing MARAFIQ safety policy / procedures requirements and ensuring strict adherence and compliance by contractor personnel under his control.

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2.3 CONTRACTOR PROJECT HSE OFFICERS

To ensure certain level of competency & knowledge, the contractor HSE Officer(s) shall be interviewed, evaluated & approved by MARAFIQ Industrial Security Department – Safety section, and feedback to MARAFIQ sponsoring department manager.

The main responsibilities of the contractor HSE Officer are as follows:

- To co-ordinate and monitor implementation of the requirements of MARAFIQ HSE manual and arrange continuous and formal daily safety monitoring to ensure compliance and effectiveness.
- Prepare regular toolbox safety letters & monitor the appropriate cascading of safety information along with site supervisors and managers.
- To liaise with and support area engineers/supervisors to promote safety awareness in their area of control.
- To detect, identify, analyze, control and eliminate recognized hazardous acts, condition, behavior and violation.
- To investigate and report immediately in writing all accidents, unsafe acts/conditions and nearmisses which occurred at work site. The report shall be submitted to contractor Project General Manager, MARAFIQ sponsoring department manager & Safety section.
- To prepare & review risk assessments & monitor effective implementation.
- To monitor correct use of safety barriers, both solid (e.g., covering holes/open handrail) and soft (e.g., isolating areas with tape), including timely removal.
- To co-ordinate with MARAFIQ safety representatives and set the safety inspection schedule as required, and report / correct findings immediately.
- To audit and record "on-the-job" and toolbox talks by supervisors.

2.4 FIELD SUPERVISORS/FOREMEN

- Contractor's field supervisors are responsible for ensuring effective implementation of Safety &
 Fire Prevention Management Plan in all areas under their direct control.
- Field supervisor's reports shall include inspections, tool-box meeting and near-misses. These reports should be given to the contractor HSE Officer(s) immediately.
- Are responsible for implementing HSE rules, regulations and work site procedures during all phases of work at MARAFIQ site.
- To anticipate HSE problems in their work areas and take the necessary actions.
- To report any incident/accident, unsafe acts/conditions and near misses to their HSE Officer.
- To ensure work places are kept clean during and at the end of the work.
- To inspect and report any defect for any equipment and take the necessary action.
- To ensure that employees have received adequate information or instruction to carry out their work safe and as required.
- To Inform the working crew of the requirements of the Permit to Work Certificates & Risk Assessments.
- To correct unsafe acts/conditions raised by observers.

2.5 EMPLOYEES





- Each employee is responsible to comply with MARAFIQ safety rules, regulations and to follow his supervisor/foreman's instructions.
- To immediately report any hazardous situation and accident to his supervisor/foreman.
- To keep his workplace clean and tidy.
- All employees shall make every endeavor to ensure that working conditions are maintained in a healthy, safe and environmentally acceptable standard.
- All employees will act responsibly and take all necessary precautions to protect themselves and their fellow workers and other persons who may be affected by their activities from injury, and prevent illness.

3.0 PROCEDURES

Following are the general requirements. Contractor shall fully comply with MARAFIQ safety manual requirements, Permit to Work & isolation procedures and risk assessment.

3.1 RISK ASSESSMENT

- Risk assessments for high risk activities shall be carried out before start of work.
- Where jobs are identified as high risk, a written risk assessment must be prepared & reviewed by the contractor and should be verified by MARAFIQ coordinating department & Safety section and approved by Operations department/area owner.
- Team supervisors shall cascade all risk control measures stipulated in the written risk assessment to their subordinates and apply on site.

3.2 PERMIT TO WORK (PTW)

Work shall be carried out in compliance with the MARAFIQ PTW procedure (SP-014). It is a requirement that all permit issuers/receivers have completed the MARAFIQ PTW safety course successfully and passed the written and oral test.

3.3 EMERGENCY

On hearing the emergency fire or gas alarm in the area of work, the following steps must be carried out by all personnel:

- Dial 341-9911 for Jubail and 396-6333 for Yanbu and inform help desk of the emergency
- Stop the assigned job, turn off the equipment and proceed to Emergency Assembly area, if safe to do so.
- Walk across wind direction to the designated Emergency Assembly area in case of a gas alarm.
- If you are driving a vehicle, stop, stop engine, and vacate the vehicle (leaving the key in the ignition if the vehicle is parked at undesignated parking area) and walk towards the assembly area.
- Do not return to work until emergency is declared over by notification from immediate supervisor.

3.4 PERSONNEL PROTECTIVE EQUIPMENT (PPE)

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- Safety helmet, safety shoes, long sleeve shirt/coverall and eye protection are mandatory.
- Ear defenders (plugs or muffs) must be worn in areas where hazardous noise level exists.
- Respiratory protection must be worn where possibilities of dust, fumes or toxic gases exist.
- Full body harnesses must be used when working at high elevations.
- Work permit & risk assessment will define any additional PPE according to the nature of work and area involved.

3.5 VEHICLES/EQUIPMENT

- Vehicles/equipment shall be driven/operated only by the authorized drivers/operators who have a valid driving license.
- Drivers must obey MARAFIQ traffic rules and regulations. The use of safety belts is required for driver and all passengers.
- Vehicles must be parked properly in designated parking areas and should not obstruct firefighting equipment & emergency exit.
- Drivers shall ensure that any material extending more than one meter beyond the front or rear of the vehicle shall have a red flag, fastened at the end of the load.
- When parking or leaving the vehicle outside the approved parking areas, the engine must be shut off, the parking brake engaged and the key shall be left in the car.
- Vehicles/equipment must be checked and maintained in good condition all the time.
- Re-fuelling of vehicle/equipment is prohibited while engine is running.

3.6 COMPRESSED GAS CYLINDERS

- Ensure that all cylinders are labeled with the correct contents.
- Oil and grease must never be used on the movable parts of oxygen cylinders.
- Gas cylinders shall never be vented into the atmosphere.
- Store cylinders in upright position and secure them in the shade.
- Place valve cap on cylinders when not in use.
- Store gas cylinders containing flammable/combustible gases away from those containing over or highly reactive materials as per standards.
- Store empty cylinders separately, clearly marked empty.
- Always use cylinder carrier/trolley when moving cylinders. The cylinders must be capped and secured inside carrier before transport.
- Protect cylinders from heat, chemicals, flammable liquids or fumes, or corrosive materials.
- Care shall be taken during handling of cylinders.
- Never lift a cylinder by its protective safety cap.

3.7 WELDING/CUTTING

The following steps shall be completed before commencement of work:

- Issuance of the Permit to Work certificates.
- The initial cut on the gas/chemical and other flammable lines shall be done in the presence of the APR.
- Work area is cleaned from all combustible materials.
- Work area is screened with fire blanket to prevent sparks from flying outside the welding area.





- Fire extinguisher is available at the work site and shall be in good condition.
- Personnel executing the work are wearing PPE according to job requirement.
- Fire watch must be in attendance while welding or cutting is in progress.
- Welding equipment is properly earthed.
- Welding machines must be inspected, and shall be in good working condition.
- Gas cylinders are equipped with flash back arrestor between regulator and hoses and between torch & hose.
- Ensure that regulators are used properly and gauges are checked and calibrated.
- Make sure that regulators, hoses and fittings are inspected and are in good condition.
- Keep hoses clear from traffic lanes.
- Open the valve slowly and check for leaks before commencement of work.
- Never leave pressurized hoses unattended in confined spaces; cylinders shall be switched off.

3.8 ELECTRICAL HAND TOOLS

- All items which are placed in tool containers shall be properly stored to avoid accidents.
- Inspect and ensure that tools are in good condition before use.
- All electrical tools and equipment must be properly maintained in good working condition.
- Always carry tools in bags/boxes when ascending or descending ladders.
- Ensure cable plug sockets and/or connectors are in good condition before use.
- Do not try to repair tools if not authorized.
- Equipment power switch must be in off position before plugging into power source.
- Before using any electric tool, make sure that you are using the correct power supply.
- Never stand on wet surface when using electrical equipment.
- Keep electrical equipment dry and clean.
- Disconnect power from equipment when it is not in use.
- Electric power tools should be regularly inspected and maintained by competent electrician.
- Electrical equipment that are to be used in the wet area should be compatible and intrinsically safe.

3.9 LADDERS

- A temporary or permanent working platform or stage, where practical, is recommended.
- Inspect ladders before use and report all defects. Do not use defective ladders.
- Make sure that ladders are tied near the top or arrangement must be made to prevent the ladder from slipping outwards or sideways.
- The foot of the ladder should be supported on a firm level surface and should not rest on a drum or a box or any unsteady base to get extra height.
- Place the ladder at a suitable angle (75°) to minimize the risk of it slipping outwards (one meter out for every four (4) meters in height).
- Rest the top of the ladder against a solid surface.
- Do not use the last two steps from the top of the ladder; the ladders should extend at least 1.05 meters above the platform.
- Use both hands when ascending on or descending from a ladder; use tool bags for lifting tools.
- Do not overreach from a ladder, always move it.
- Ensure firm grip of hands and feet before moving on to the next step to avoid slipping.
- Area around top and base of the ladder must be free from tripping hazard.
- The ladder is of suitable quality for industrial use.



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3.10 CONFINED SPACE ENTRY

- No one is allowed to enter a confined space, unless Permit to Work certificates are issued and all safety requirements mentioned in the Permit to Work have been met.
- Only appointed workers are allowed to enter confined space.
- Ensure all personnel protective equipment are inspected and in good working condition.
- Ensure the standby attendant is fully aware of his responsibilities.
- Ensure that Permit to Work certificate is valid and displayed at job location.
- If work is stopped for any reason and the confined space is vacated, "NO ENTRY" sign must be displayed on the entrance of the confined space, i.e., column, vessel, tank, etc.
- Standby attendant should be trained and certified by MARAFIQ.
- Gas cylinders are not allowed inside the confined space.
- For welding activities inside the confined space, local or forced-air ventilation should be used.

3.11 LIFTING OPERATION/EQUIPMENT

- All lifting equipment (cranes, forklifts, chains, man-basket, lifting belts, tackles, etc.) must be inspected prior to use and are in compliance with all regulations and guidelines and certified by a third party.
- Make sure that the safe working load is indicated clearly on the lifting equipment. Do not exceed the maximum lifting capacity of the equipment.
- Use the right lifting equipment for the job.
- A guide rope (tag line) must be used to control objects while lifting.
- Working/lifting area should be barricaded.
- Supervisor, lifting operator and rigger is aware of the scope.
- Lifting operators should be certified by 3rd party Inspectorate recognized by Saudi Government and copies of certificates should be submitted to MARAFIQ Safety section prior to bringing them on site as per MARAFIQ safety manual.
- Permit to Work certificate must be obtained prior to start of the job.

3.12 **SCAFFOLDING**

- Scaffold structure shall be erected by certified scaffolder.
- Inspect scaffolding prior to use. Use only scaffolding that is certified for use with a green tag.
- Make sure scaffold is firmly supported.
- Do not overload scaffold; distribute the load.
- Do not leave material on scaffold.
- Mobile scaffold should be used on flat level surface and shall have four (4) wheels locked to ensure stability. No persons or materials may remain on the tower while it is being moved.
- The frequency of inspection shall be seven (7) days as per MARAFIQ safety manual.
- Scaffolding shall be modified only by qualified scaffolders.
- Scaffolders should wear full body harness during erection/dismantling or alteration and stand/work on platform with minimum two (2) boards.
- Steel boards shall be used if the erected scaffold is in contact with hot surface.
- Scaffold fittings (i.e., joints, pipes....etc) should be lowered by hands or rope safely.



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3.13 FIRE PREVENTION

- Smoking is permitted only in designated smoking areas.
- Smokers should ensure that cigarette butts are extinguished properly before leaving their designated smoking areas.
- Burning of rubbish or any other material, at site is strictly prohibited.
- Do not obstruct access to fire extinguishers or other firefighting equipment.
- Ensure a safe access to all work areas is maintained.
- Do not allow paper, oily rags or any other rubbish to accumulate at your working area.
- Do not use fire hydrants or fire hoses/equipment except for firefighting purposes.

3.14 HOUSEKEEPING

- High standards of housekeeping should be maintained during & after completion of the work.
- Site (both ground floor & elevated platforms/levels) must be kept clean and in a tidy condition, with cables and hoses coiled up and stored in a safe place.
- Waste material should be collected and removed from the work area and placed in waste drums or trash skips on a regular basis to arrange required level of housekeeping.
- Housekeeping inspection shall be carried out on regular basis.
- Wastes shall be dropped in the designated bins.
- Waste bins shall be emptied regularly to avoid overfilling.

3.15 PREVENTION OF FALLING OBJECTS

- The hand tools should be tied with a cord and attached to the belt of the technician.
- Bins or bags should be provided for storage of nuts, bolts and other small Items.
- A sheet should be laid to cover all gaps and openings, if working above on a platform having grating on it.
- Tools. materials, etc., should not be thrown from the heights but shall be brought down by a rope, bucket or crane.
- The area should be cordoned off and no one should be allowed to cross under during lifting.
- Ropes/slings should be inspected each time before use.
- Suitable arrangement shall be made for the people above and below elevations, in one location.

3.16 MEDICAL & WELFARE FACILITES

- The contractor shall ensure and maintain compliance with Ministerial Decision 404 and Saudi Arabian Labor Regulation Article 134 regarding work site requirements from the Minister of Health
- All eating and sanitation facilities (either shared or contractor-controlled) shall be maintained in a clean and sanitary condition at all times.
- Food shall not be consumed in any area "onsite" that is not designated as an approved eating area.
- Contractor shall provide clean, potable cooled drinking water in sufficient quantity for its employees in a safe and hygienic manner at all sites.
- Toilets, bathrooms, washing facilities & rest room should be provided with enough supply water and other required necessities.



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- The number of chemical toilets shall be at least 1 per 15 personnel on site with regular daily cleaning.
- Prayer rooms shall be arranged either within the office, separate cabin, etc., depending on the site requirements.
- Shelters for heat/cold stress, smoking, bus stop, etc., shall be provided as needed throughout the project.

3.17 LAYDOWN AREAS

- Contractor shall coordinate with project owner for allotment of laydown area(s) prior to mobilization to site.
- Contractor shall prepare clear layout sketch of laydown area and get approved by coordinating department's responsible engineer prior to commencement of the contract work.
- Layout should indicate clearly contract work area, boundary fence, lighting, access points, internal routes and laydown area for offices, temporary workshops, parking, storage, warehouse, toilets, first aid clinic, etc.
- Consideration for drainage & protection from rain ad sand storms shall be made.
- All required welfare facilities, rest, eating, praying area, shelters, etc., should be provided on site and should be maintained in tidy, clean and good hygienic condition.
- An assembly point shall be established in each laydown area for emergency purposes.

3.18 DISCIPLINARY ACTION

MARAFIQ safety rules and regulations will always supersede contractor's disciplinary guidelines. At MARAFIQ's discretion, employees may be removed from the project when committing unsafe acts, depending on the extent and severity of the violation.

The employees committing HSE violation will be dealt with in accordance with the respective company's rules and regulations.

4.0 TRAINING

4.1 SAFETY INDUCTION

All persons working on MARAFIQ facilities shall have completed the MARAFIQ safety induction course and have passed the competency test.

4.2 PERMIT TO WORK (PTW)

It is a requirement that all supervisors who are required to receive Permit to Work Certificate (PTWC) for performing intended contract works in MARAFIQ areas must have successfully completed the MARAFIQ PTW course; passed the written and oral test and possess authorization card issued by MARAFIQ PTW authorization committee as Authorized Permit Receiver (APR).







4.3 BREATHING APPARATUS & EQUIPMENT CERTIFICATION

All personnel utilizing breathing apparatus for activities at MARAFIQ must be trained and certified. Certifications will vary depending upon the type and/or manufacturer of the equipment.

4.4 SUPERVISOR BRIEFING

Each supervisor will endorse and accept the responsibility to comply with the requirements of MARAFIQ safety manual.

4.5 STANDBY ATTENDANT (FOR CONFINED SPACE ENTRY)

- Trained personnel will assume the role of standby attendant for activities involving confined space entry. The only approved training course is offered by MARAFIQ Loss Prevention (Loss Prevention (LP))/Safety section. Candidates who have successfully completed the course will be authorized to carry out standby attendant activities. Authorization card will be arranged for successful individual, which is valid for three (3) years.
- Record will be maintained by MARAFIQ Loss Prevention (LP)/Safety section in case a check is carried out by MARAFIQ.

4.6 SCHEDULE OF TRAINING & NUMBER OF MANPOWER

The following safety training courses will be conducted by MARAFIQ Loss Prevention (LP)/Safety section. Prior coordination shall take place by contractor safety representatives.

- Safety Induction
- Permit to Work
- Standby Attendant for Confined Space
- Safety Procedures Awareness
- Authorized Gas Testers

5.0 SAFETY INFORMATION, GUIDELINES AND COMMUNICATION

The following tools of communication will be used at site and shall be kept as a record:

- Safety Audit Forms
- Tool Box Talk
- Safety Letters
- Safety Meetings
- Safety Posters

5.1 TOOL BOX TALK

Tool box talk will be conducted weekly by supervisors prior to the start of work. These will be audited by MARAFIQ Safety section. The toolbox talk will include, and not limited to, the monthly safety topic, safety advice, safety observation, and incidents which occurred along with learning points.



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5.2 TEAM TALKS

- Team talks will be conducted by supervisors prior to starting each task. These will be audited by MARAFIQ Safety section.
- There will be a short discussion with the team about the tasks to be carried out and should include the following:
 - Details of the task and hazards that may arise.
 - Details of risk assessment where applicable.
 - Permit conditions.
 - Work methodology.
 - Personal protective equipment requirements.
 - Equipment and tools shall be used.
 - Feedback from the working crew about the method of work.
 - Feedback from any safety learning points.



5.3 HEALTH, SAFETY & ENVIRONMENT LETTERS

HSE letters will be circulated to all employees reporting/highlighting any health or safety topic for educational purposes. The HSE letter will be issued by the contractor Safety Officer on weekly basis.

5.4 HEALTH, SAFETY & ENVIRONMENT POSTERS

HSE posters will be designed, produced by the contractor & displayed regularly around the work site in an attempt to increase safety awareness.

6.0 HEALTH, SAFETY & ENVIRONMENT REPORTING

6.1 HSE SUGGESTIONS

- All employees are encouraged to make HSE suggestions. A form should be made available for this purpose.
- HSE incentive programs should be designed & organized by the contractor to reward the employees/departments who contribute in the HSE suggestions and/or comply with safety requirements. Details of the HSE suggestion and incentive programs will be distributed to all employees prior to the start of the program.

6.2 **NEAR-MISS / INJURY REPORTING**

- Near-miss incident: it is an incident that could have caused property damage or personal injury. Near-miss incidents, when not corrected, will contribute to accidents.
- All near-miss and/or injuries must be reported immediately to the first line supervisor/foreman and contractor HSE Officer. The MARAFIQ accident/incident report form is shall be completed within 24 hours.
- Contractor HSE Officer shall report all incidents, including near-misses, to MARAFIQ Safety section immediately.
- Copy of the near-miss/incident report will be kept available with the contractor HSE Officer.



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7.0 HEALTH, SAFETY & ENVIRONMENT MONITORING

- All line supervisors shall be involved in health, safety and environment site inspections. The inspections will be in line with MARAFIQ site inspections procedure & forms.
- The contractor HSE Officers will jointly develop a schedule and provide copy of the forms for the monitoring, to all concerned line managements. They will also co-ordinate the actions arising from the returned forms.
- HSE Officer will utilize learning's from these inspections for safety letters & posters.
- Contractor's HSE Officer shall conduct HSE inspections on a daily basis, report findings & follow up the implementation of corrective actions.





